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Fig. 1.—60-Cycle, 250-hp. Polyphase Motor Driving Williams Mill and Crusher.

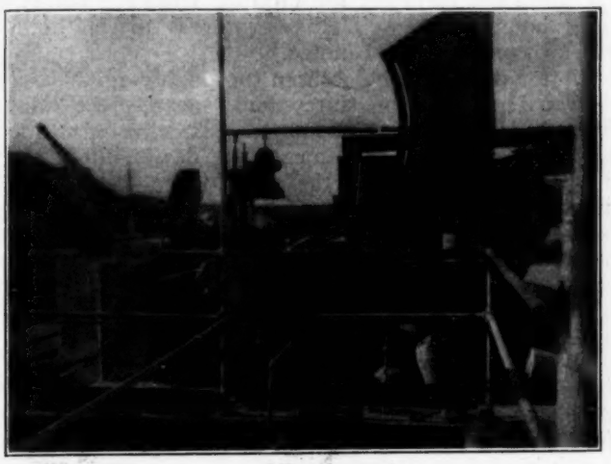

Fig. 2.—¼-hp., Single-phase Motor Driving Kiln-Slurry-Feed Control Dipper.

Electrical Equipment of Western Portland Cement Plant

California Cement Plant Driven Completely Through Motors Supplied from Power System—Features of the Equipment — Practically Dustless Operation Secured

APPLICATION of electric drive in the operation of a cement mill and the advantages to be derived therefrom are unusually well exemplified in the plant of the Southwestern Portland Cement Co. at Victorville, Cal. The town of Victorville is in the southern part of California about one hundred miles from the city of Los Angeles on the Santa Fe Railroad, the tracks of which pass by the plant, affording a convenient outlet for the finished product.

The mill has an output per year of approximately 300,000 bbls. of Portland cement, and employs an average of about eighty men. All of the buildings are of substantial reinforced concrete construction built to withstand the severe conditions imposed by the heavy cement mill machinery installed.

The system of manufacture used is known as the "wet process," and the water required for use throughout the mill is raised to a reservoir on a hill back of the plant by a 15-hp. motor-driven triplex pump.

Electric current is purchased from the Southern Sierras Power Co., thus relieving the cement company of the expense and trouble incident to the operation of a power plant. Current is received at 33,000 volts and stepped down to 440 volts for application to the various motors installed throughout the mill.

All the transformers and the switching outfits are of the outdoor type, located immediately adjacent to the mill. The current is taken from here to a seven-panel marble switchboard, from which it is distributed to the various power and lighting circuits in the mill.

Rock and shale are brought to the mill from the quarry, which is located seven miles distant, by steam locomotive hauling trains of cars which have two compartments or hoppers, one of which is dumped at a time into the crusher hopper.

The lime rock is delivered from the hopper cars direct to the crusher, but a reserve pile of crushed stone, amounting to between 3000 and 5000 tons is maintained sufficient to keep the mill operating for a period of approximately 30 days. This reserve is maintained in the event of an accident, such as a washout, crippling the railroad service from the quarry to the mill.

The crusher and Williams mill are driven by a 250-hp. Westinghouse type CW wound-rotor motor, shown in Fig. 1. Here the rock is broken into pieces about the size of a walnut or a little larger. From here the rock is elevated to a storage bin by a bucket elevator, driven by a 30-hp. motor, and thence by belt conveyor to the pulverizing house. Up to this time no water has been put with the rock except what is thrown on at the time it goes into the crusher, which

is done with a hose to eliminate whatever dust rises at that time.

During the process of pulverization, water is added for further eliminating the dust. After being thoroughly pulverized the mixture is taken to the slurry tanks, where it is kept in motion by air agitation until ready for admission to the kiln.

There are six slurry tanks served in pairs by elevators, operating at a speed of approximately 88 ft. per min., for elevating the mixture from the pulverizing house tanks. Each elevator is driven by a 7½-hp. constant-speed motor.

After the mixture has been thoroughly agitated, it is transferred to the slurry tanks nearest the kiln. From here it flows into a sump and is delivered to the kiln by a motor-operated measuring device illustrated in Fig. 2, which shows the rear of the scale. The dipper is made in the shape of the letter "S," the outlet being in the center. By raising and lowering the dipper in the sump the amount of slurry entering the kiln can be controlled. The dipper is driven by an extended shaft, provided with two universal joints, from one of the elevators and is raised and lowered by a ¼-hp., 1725-r.p.m. motor by means of remote control from the klinker end of the kiln. The large scale is visible to the operator at the klinker end and he can feed the proper amount of mixture to the kiln and watch his fire at the same time.

The rotary kiln is approximately 200 ft. long and 20 ft. in diameter, lined with firebrick and heated by an oil burner to a temperature of about 2500° F., which is measured by a radiation pyrometer. It is driven at a speed of one revolution per minute by a 50-hp., type CW, 700-r.p.m. motor through Foote reduction gears, as shown in Fig. 3. The kiln is elevated at the raw end, so that as it rotates the mixture will travel toward the klinker end. Upon coming from the kiln the klinker falls about 20 ft. into a pit to allow it to cool somewhat. It is then elevated by the klinker elevator, which is driven by the 7½-hp., 680-r.p.m. motor shown in Fig. 4 to an automatic scale and dumped into the storage bin.

From the klinker storage it is transferred by means

Fig. 3.—50-hp., Three-phase Motor Driving Rotary Kiln Through Foote 14 to 1 Reducer at 1 r.p.m.

of a locomotive crane with a clam-shell bucket to a bin from which it is fed into the finishing mill. The locomotive crane is also used for mixing the klinker as it will vary somewhat in quality. After being ground and analyzed by the chemical department, it is ready for the packing house, to which it is carried on a belt conveyor over a weighing machine, which automatically records the number of barrels that pass.

From the storage bins, the cement is taken to the sacking machines, driven by a 15-hp. motor. A sack cleaner is driven by a 7.5-hp., 680-r.p.m. motor through a Foote reduction gear. A 15-hp. motor-

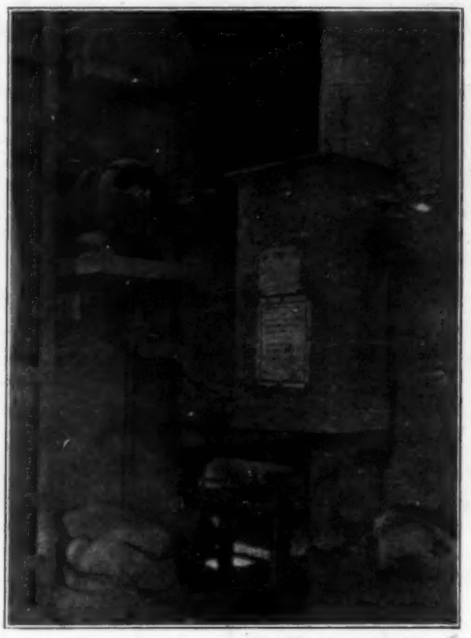

Fig. 4.—7½-hp. Motor Driving Klinker Elevator.

driven blower for collecting dust from the sacking and sack-cleaning machines is also used.

All the motors are of the alternating-current, 440-volt, 60-cycle, three-phase type and were furnished by the Westinghouse Electric & Manufacturing Co.

This plant was designed and built by L. D. Gilbert and has been in operation over three years, during which time no shutdowns have been experienced due to any trouble with the electrical equipment described.

NEON VAPOR LAMPS FOR HIGH VOLTAGE AND LOW CANDLEPOWER.

Previous endeavors to manufacture metal-filament lamps which could give 10 cp. or even less, and operating on the 220-volt lines generally used in many European countries, have been a failure in that the strength of the filaments has been found to be very low. A satisfactory solution of this problem is claimed to have been arrived at by two scientists working in the Pintsch laboratories in Berlin.

The lamp designed by them can be manufactured for a current consumption of only 1 to 5 watts and can be connected to any 220-volt network. It is provided with an ordinary lamp bulb and a standard base, and contains in a clear glass bulb a mixture of neon and helium gas at 8 to 10 mm. pressure. In this bulb is a large surface cathode, and, opposite it, an anode, placed at such a distance that at 190 volts pressure a dim discharge is set up which forms the luminous yield of the lamp. The remainder of the voltage is absorbed by a series resistance, the size of which is arranged to suit the current absorbed by the lamp. This resistance is concealed in the lamp socket. In order to change the color of the light given from orange red to pinkish-white, a little mercury vapor can be added to the gas charge.

Central-Station Rates in Theory and Practice

Nineteenth Article—Combined Energy and Demand Rates—Substitutes for Measured Demand—Encouraging Use of Appliances—Hopkinson, Doherty and Wright Rate Systems — Combination Rates

By H. E. EISENMENGER

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This is the nineteenth article of this series which began in the issue of July 12. Part I of the series included seven articles dealing with the cost of central-station service. Part II comprised six articles on the policies governing the choice of a rate system. The present article is the sixth and last of Part III discussing the various systems of rates in use. The remaining six articles will constitute Parts IV to VI and will treat of rate analysis, the accuracy of rates and the current practice in rate regulation by commissions, the last article appearing in the issue of Dec. 27.

PART III—SYSTEMS OF CHARGING—Continued.

II. The Various Types of Rates—(Continued).

D. Rates Based on Both Energy Consumption and Demand—(Continued).

2d. Substitutes to Approximate the Measured Demand.

2. The Various Substitutes for the Measured Demand.

a. Size of Transformer Required.

SECTION 142. To begin with a rather isolated type of substitutes for the measured demand, the size of the transformer actually required for the customer's service may be used as the measure of his maximum demand.[1]

b. The Connected Load.

143. A very frequent substitute for the measured maximum demand is the connected load of the customer in some form or other.

Sometimes the measured demand and connected load are used together in such a manner that the measured demand is limited by the connected load so that the demand is never counted as less than a certain specified percentage of the connected load.[2]

1. The Full Connected Load.—The full connected load as the determining factor of the demand charge is used mostly in power rates,[3] although lighting rates on the same basis can also be found.[4]

The unit of the connected load in these instances is, in case of power rates, frequently the horsepower connected, for instance, the rating of the motor or motors.[5] Otherwise it may be the load in watts or kilowatts as determined by inspection of the installation.[6] The use of the number of 50-watt units installed,[7] or the rather obsolete method of using the 16-cp. lamp or equivalent,[8] as unit for the connected load are varieties of this rating.

2. Percentages of the Full Connected Load.—Instead of the full connected load a certain percentage of the load is very frequently made the basis of the charges and that percentage may be either a fixed one[9] or it may vary—within the same schedule[10] or from one schedule to the other[11]—with the character of the business served.

144. The percentage of the connected load which is to constitute the rated demand is frequently also varied with the *size of the connected load.* This is justified by the following considerations.

With a very small load, consisting, for instance, of one lamp or a very few lamps, the maximum demand will be equal to the connected load. If we have a larger installation the chances are in many installations that not all lamps will burn at the same time. The various lamps will have a diversity among themselves which in the average will be the greater, the larger the installation's capacity is in kilowatts. The same applies to power loads, especially where we have more than one motor installed. The chance that these motors will never be all running at the same time at full load is the greater the larger the number of motors is. Where we have one motor only, even if it be driving a number of power-consuming devices which have a diversity amongst one another, we must assume that this diversity had been anticipated when the selection was made of the size of the motor. At

[1] The Electric Welder Service schedule of the Standard Electric Light Co. of Kansas City: Transformer capacity connected for each service.
All schedules of Lansing, Mich., where the demand enters into the rates: Transformers actually required.
Wholesale Power schedule, Erie, Pa.: 75% of the transformer capacity, where installation is greater than 15 kw. (otherwise demand is measured).

[2] Wholesale Lighting and Power schedule, Norfolk, Va.: The demand is never to be counted as less than one-half the connected load.

[3] For instance, in the Wholesale Power rate of Denver, Colo., a three-charge rate system where the monthly demand charge is $2 per horsepower connected.
The Wholesale Power schedule of Omaha (which applies also to lighting where this is not more than 20% of the total load) determines the demand as the motor rating of the connected load, not counting the portion formed by the lighting load.

[4] For instance, in the Retail Lighting Schedule of Washington, D. C., or in the Residence Lighting schedule of Pueblo, Colo., (Wright demand rates).

[5] See footnote 3 above.

[6] See footnote 4 above.

[7] One of the two optional Commercial Lighting rates in Rockford, Ill., is a three-charge rate with a monthly demand charge of 16.6 cents per 50 watts connected.

[8] Denver, Colo.: Combination Lighting schedule, which is a three-charge rate system with a monthly charge of 15 cents per 16-cp. lamp.

[9] General Power, Haverhill, Mass.: For smaller installations 75% of the connected load or by test, but never under 60% of the connected load.

[10] The General Lighting Schedule in Brooklyn rates the demand as 50% of the connected load in residences and 70% elsewhere, with exception of sign lighting where the full connected load is used.

[11] Buffalo: The Residence Lighting schedule and the Commercial Lighting schedules are identical except that the demand in the former schedule is determined as 25% of the total installation and in the latter schedule as 50%. The minimum rated demand for residences of 250 watts is accordingly raised for commercial lighting to 500 watts.

the same time the choice of a smaller percentage for the rated demand in larger installations expresses the principle of granting lower unit prices to the larger consumer.

The percentage which determines the rated capacity is therefore reduced as the *connected load* increases or as the *number of motors* in the installation increases, or both.

145. Where the connected load is the determining factor of the percentage—which is quite frequent practice—we can use methods entirely analogous either to the "step" or the "block" method, explained in the description of the step meter rate and the block meter rate, respectively (Sections 119 and 122). The same laws which govern the decrease of the energy charge per kilowatt-hour with increasing energy consumption in the step and block meter rates apply here to the decrease of the percentage with increase of the connected load.[12]

As regards those rather infrequent cases where the number of motors installed is used to determine what percentage of the connected load is to make up the rated demand, the simplest conceivable method, and the only one used in practice, is to state how large the percentage of the connected load is which corresponds to every number of motors. Usually only two or three different percentages are used in this manner; for instance: one for one motor, another one, say, for two to five motors, and the third one for more than five motors.

The use of the number of motors alone, without any reference to the size of the connected load, does not occur. It is either combined with the step or block method of the connected load as just described in such a manner that the percentages for the various numbers of motors are different for the different steps or blocks of the connected load[13] or the use of the number of motors applies to a certain range of the connected load only and outside of that range the percentage is entirely independent of the number of motors.[14]

Another measure to take into account the effect of the diversity of the motor loads can be made by assigning a lower percentage of the connected load to the rated demand if the motors are driving a group of power-consuming machines than if we have individual drive of the power-consuming devices. In both cases we will have the same diversity between the power demands of the various machinery,[15], but in case of the group drive—if the size of the motors has been chosen intelligently—the diversity of the loads on an individual motor has been anticipated and the capacity of the motor, that is the "connected load," is selected correspondingly smaller than in case of the group drive, although the character of the mechanical load on the motors is exactly the same in both cases. Consequently the actual maximum demand is a larger percentage of the motor capacity in case of group drive than in case of individual drives[16].

In a few cases the size of the largest motor installed is chosen to determine the percentage of the connected load which is to form the rated load. In these cases the block method is used: The rated demand is a certain percentage of the capacity of the largest motor plus another percentage of the rest of the connected load.[17]

146. Instead of reducing the percentage of the connected load which is to be used as the basis for the determination of the rated demand, we can get the same numerical results by rating the demand as the full connected load and reducing the demand charge accordingly. Whichever law—step or block—we use for the reduction of the percentage of the connected capacity, the same law will apply to the equivalent reduction of the unit demand charge and the latter will be reduced in the same proportion as the per-

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[12]Step method: Power rates, Cincinnati:

Connected Load.	Rated demand in % of connected load.
Under 5 hp	90%
5 to 10 hp	75%
10 to 20 hp	70%
20 to 50 hp	65%
50 to 100 hp	60%
100 hp. and over	55%

Block method: Optional Commercial Lighting schedule, Bay City, Mich.:

Connected Load.	Rated demand in % of connected load.
First kw	95%
Next kw	90%
Next 2 kw	85%
Next 6 kw	80%
Over 10 kw	Varies with the class of business.

[13]A. Combined with steps of connected load:
1. Optional Commercial Lighting and Power schedule, Cleveland:

Connected load.	One motor.	Two or more motors.
Up to 5 kw	80%	75%
5 to 10 kw	75%	70%
Over 10 kw	70%	65%

2. Wholesale Power, Newark:

Connected load.	One motor.	Two or more motors.
Up to and incl. 50 hp	70%	60%
Over 50hp	70%	50%

B. Combined with blocks of connected load:
General Power schedule of the Portland Railway, Light & Power Co., Portland, Ore.:

Connected load.	One motor.	2 to 5 motors.	Over 5 motors.
First 5 kw	95%	90%	85%
Next 5 kw	75%	70%	65%
Excess	65%	60%	55%
Minimum	75%	70%	65%

[14]Retail Power schedule, Philadelphia:
Rated demand:
One motor connected—85% of connected load
Two or more motors connected—75% of connected load
} If less than 10 hp. are connected.

Optional Power schedule, Lancaster, Pa.:
Rated demand:
One motor connected—85% of connected load
Two or more motors connected—80% of connected load
} If 25 to 50 kw. are connected.

When the connected load is different from that specified (under 10 hp. or between 25 and 50 kw., respectively) another method of determining the rated demand applies.

[15]This means that their joint maximum demand will be smaller than the sum of their individual maximum demands because their maxima do not occur at the same time.

[16]This discrimination of the demand charges between group drive and individual drive is very rare; only one example could be found, that is the Retail Power schedule of Wilmington, Del.:

Connected load. Kw.	One motor.	Two motors. Group.	Two motors. Indv.	3 to 5 motors. Group.	3 to 5 motors. Indv.	6 to 10 motors. Group.	6 to 10 motors. Indv.	11 to 19 motors. Group.	11 to 19 motors. Indv.	Over 19 motors. Group.	Over 19 motors. Indv.
Under 3		98%	95%								
3 to 4.9	99%	97%	93%	90%	82%						
5 to 9.9	97%	95%	90%	88%	80%	85%	78%				
10 to 19.9	95%	92%	86%	85%	77%	82%	73%	75%	68%		
20 to 49.9	93%	90%	83%	82%	75%	78%	70%	73%	65%	70%	62%
50 to 99.9	92%	85%	78%	80%	72%	75%	68%	70%	62%	68%	60%

[17]Wholesale Lighting and Power schedule of San Francisco: For installations under 50 hp. the demand may be estimated at the option of the company as 100% of the rated capacity of the largest motor installed, plus 60% of the rated capacity of the additional motors or other devices.

Retail Power, Louisville:
Up to 10 hp. connected—30% of largest motor
10 to 50 hp. connected—25% of largest motor
Over 50 hp. connected—20% of largest motor
} +40% of the total connected load.

This might also be written to conform with the form of expression chosen above, as:
Up to 10 hp. connected—70% of largest motor
10 to 50 hp. connected—65% of largest motor
Over 50 hp. connected—60% of largest motor
} +40% of the capacity of the additional motors.

centages of the connected load have been reduced.[18] Both principles of reduction—step and block—are sometimes found combined with each other as block-block, step-block or step-step systems. For instance, the percentage of the connected load decreases with increasing connected load according to the block law and the unit demand charge also decreases with the increasing connected load according to the block law. This "block-block" or "double-block" system can be reduced to one single-block system[19] either based on full connected load instead of percentages of the same and employing a varying demand charge or, if preferred, with a constant demand charge and varying percentages of connected load. (This does not mean that either of these single-block systems is always preferable to the double-block system or vice versa; the fact is mentioned here only as an instance of the interchangeability of various forms of rates with the same numerical effect, to introduce the reader to the methods of analyzing the meanings of the various rate schedules). Similarly a "double-step" system is equivalent to a "single-step" system with the number of steps generally equal to the sum of the numbers of steps in the two systems. Finally a "step-block" system is conceivable which would be resolved into a combined step and block system, again either based on full connected load, or with a constant demand charge.

147. The block and the step method and their combinations are the simplest methods of varying the demand charges with the connected load. There are other methods which are very frequently used. In these the demand charges depend on the energy consumption as well. The demand charge is then generally altered not when the *demand* but when the *load-factor* exceeds a certain limit. These less simple methods will be discussed later (Wright system, etc.).

c. The Number of Sockets or Outlets.

148. Just as the connected load is an approximation of the maximum demand so the number of sockets or outlets is an approximation of the connected load, and just as the introduction of the connected load in lieu of the maximum demand brings about certain advantages and disadvantages, namely an increase in simplicity and a decrease in accuracy, so this same advantage and disadvantage is correspondingly further enhanced by the introduction of the number of sockets as basis for the demand charge.

The use of the number of sockets is an exception in case of rates which are based on both demand and energy consumption. The basis for the demand may be in these cases either the full number of sockets connected[20] or a certain percentage of that number,[21] in accordance with the parallel proceedings with the connected load (Section 143).

Sockets for lights which are liable to burn a few minutes only at a time (so-called convenience lights) and for lights which are liable to burn only occasionally or not at peak-load time are sometimes exempted from the rating for the demand,[22] so as to avoid a restricting influence on the installation of the customer and to let him get the benefit of the convenience of electric lighting without unduly high charges.

d. Encouragement of the Use of Domestic Appliances. Number-of-Rooms and Floor-Area Basis.

149. Whereas in the earliest times of central-station history electricity was used in residences purely as a lighting agent, it is now being employed more and more for heating and power purposes around the house, in radiators, stoves, toasters, percolators, milk-warmers, flatirons, ranges, washing machines, vacuum cleaners, fans, battery chargers for automobiles and in similar domestic appliances.

These appliances are used as a rule at a different time of the day than the electric lights and their use increases the peak of the central station in a far smaller measure, if at all, than the use of the same capacity in lamps would. Therefore, their operation costs the central station much less than their capacity implies. Their use should be cheapened also from the point of view of the value-of-service principle, since nobody would, for instance, care to use an electric range if he had to pay the same price for current as he will-

[18] To quote a simple example, the demand charge of the (optional) Commercial Lighting rate of Bay City, Mich., is $2 (net) per kilowatt of active load and the active load is—
95% for the first kw. connected.
90% for the next kw. connected.
85% for the next 2 kw. connected.
80% for the next 6 kw. connected, etc.
This plainly amounts to the same numerical effect as if we would change the demand charge to
95% of $2 = $1.90 for the first kw. connected.
90% of $2 = $1.80 for the next kw. connected.
85% of $2 = $1.70 for the next 2 kw. connected.
80% of $2 = $1.60 for the next 6 kw. connected.

[19] The following example will illustrate this:
The Lighting and Power rate of Grand Rapids, Mich., charges a yearly demand charge of—
$24 per kw. of the first 50 kw. of active load (rated demand).
$18 per kw. of the next 50 kw. of active load.
$15 per kw. of the excess.
Plus an energy charge which is of no interest in this connection.
The active load or rated demand is determined in the following way from the connected load:
100% of the first 20 kw. connected.
90% of the next 20 kw. connected.
80% of the next 20 kw. connected.
60% of the next 20 kw. connected.
50% of the next 20 kw. connected.
30% of the excess.
To reduce this rate to one based on the full connected load we proceed as follows:
The first 20 kw. connected are evidently charged at $24 per kilowatt connected.
The demand charge for the next 20 kw. connected is obviously $0.90 \times \$24 = \$21.60$.
The demand charge is changed from $24 per kilowatt of active load to $18 as soon as the active load reaches 50 kw. We have first to determine what the corresponding connected load is.
40 k.w connected corresponds to $20 + (0.90 \times 20) = 38$ kw. rated load.
60 kw. connected corresponds to $20 + (0.90 \times 20) + (0.80 \times 20) =$ 54 kw. rated load.
Consequently 50 kw. of rated load lies in the third block of the original load system, that is, between 40 kw. and 60 kw. connected load. The first two blocks of connected load together comprise 38 kw. rated load; this leaves 12 kw. rated load reaching into the third block or, as 80% is the prevailing percentage in that block, $12/.80 = 15$ kw. connected load. The total connected load corresponding to 50 kw. rated load is therefore $40 + 15 = 55$ kw.
After 50 kw. of active load (55 kw. connected) has been reached, the demand charge changes from $24 per rated kw. to $18 per kw., that is, from $0.8 \times \$24 = \$19.20$ per connected kw. to $0.8 \times \$18 = \$14.40$ per connected kw.
In this manner we arrive by successive steps at the following table:

First 20 kw. connected	$24 per kw. connected
Next 20 kw. connected	21.60 per kw. connected
Next 15 kw. connected	19.20 per kw. connected
Next 5 kw. connected	14.40 per kw. connected
Next 20 kw. connected	10.80 per kw. connected
Next 20 kw. connected	9.00 per kw. connected
Next 80 kw. connected	5.40 per kw. connected
Excess over 180 kw. connected	4.50 per kw. connected

In the same manner we might also express this rate as a rate with one single kilowatt charge applying to different percentages of the connected load.
The reader who is familiar with elementary mathematics will find preferable the algebraic methods as described in Part IV.

[20] Residence Lighting schedule, Indianapolis, Ind.: All lighting sockets; sealed sockets, baseboard and floor receptacles for small power appliances not counted.

[21] Residence Lighting schedule, Youngstown, Ohio: Of the sockets in the principal rooms as specified in the schedule (that is, omitting closets, bath room, attic, etc.) seven-tenths are considered as 50 watts each and three-tenths as 25 watts each. Four-tenths of the wattage so obtained is then counted as the customer's demand. An easy calculation reveals that this simply means 17 watts are counted for every one of the sockets in the respective rooms. The demand charge per kilowatt may thus be reduced to a demand charge per socket.

[22] Residence Lighting schedule, Youngstown, Ohio: Lamps in the following rooms are not counted: Vestibule, porch, closets, bath room, lavatories, dressing rooms, attic, basement, pantries, summer kitchen, servant's room, back halls, back stairways, billiard room, barn and yard.

ingly pays for electric light. Moreover, the use of these appliances improves the central station's load-factor and thereby it cheapens the service eventually to all customers, because a central-station equipment which is being used 24 hours a day is able to produce the unit kilowatt-hour of energy as well as kilowatt of demand more cheaply than one used during a short period of the day only and then resting idly.

The demand and energy consumption of these appliances is as a rule quite considerable and is a large multiple of that of an ordinary household lamp. The capacity of almost any of these household appliances runs into the hundreds of watts and sometimes (ranges, etc.) into the thousands. The capacity of one or two of these devices may exceed that of the whole lighting installation. Therefore the leveling effect of these appliances on the total residential load curve can be a very considerable one.

For these reasons it is generally recognized by central-station managers that the use of domestic appliances should be encouraged in the mutual interest of the central station and of the customers.

150. The ordinary step and block meter methods, either as applied to the energy (step and block meter rate) or as applied to the rating of the demand are a step in this direction. However, with these two methods the lowering of the charges does not clearly apply to the use of appliances, but to the larger user in general.

The reduction of the charges to the user of the appliances, regardless of the amount he is using is more outspoken in the following method used by a number of central stations which base their rated demand on the connected load (either full load or a certain percentage) or on the number of sockets or outlets. The demand of the above mentioned appliances is then exempted from the rated demand [23] or it is counted at a smaller percentage than the lighting load.[24] Where the demand is rated by sockets or outlets the first receptacle in each room may be exempted.[25]

The same object of automatically allowing the residential customers a lower rate for "appliances" than for lights is at the bottom of the most modern system of residential rates, the "number-of-rooms" and the "floor-area" rates. The idea of these rates is that the actual lighting demand of a residence depends on the number of rooms or on the floor area and that the deviations from the average in individual cases are generally not large.

To illustrate this by a simple case, a demand charge might be made of a certain amount for every room or for every 100 sq. ft. of floor area, and an energy charge of, let us say, 5 cents would then be added for every kilowatt-hour consumed.

This rate, like every other one with a demand charge apparently penalizes those customers who are using their installation for a shorter time than the average customers of that class, that is, the customers with a small load-factor, inasmuch as the average price paid by them *per kilowatt-hour* is higher. Conversely, it apparently favors the customers with a large load-factor by reducing their average charge per kilowatt-hour. A special feature of the rates under discussion is the fact that the customer who has not installed lamps of sufficient size and number to give adequate illumination in the whole house is also penalized by being charged a relatively higher price, because he has to pay the same amount for the demand—though not for the energy—as if he had installed lamps of sufficient or ample total wattage. On the other hand, he gets additional service for "appliances" against payment of not more than the energy charges for the additional service.

151. The question is hard to decide whether the number of rooms or the floor area is a better basis theoretically. It depends to a certain degree on the size of the rooms, as we can see from the following. If we imagine a very large hall, an auditorium, a skating rink, or the like, the wattage required for a given illumination (with a given type of lamp, etc.) depends obviously only on the floor area. If we subdivide the hall by partitions into several smaller rooms, these partitions will cast shadows and shut off the light of certain lamps from certain parts of the floor, thereby reducing the illumination. Every room will get light only from the lamps immediately above it and the rest of the light will be lost (neglecting the fraction which is reflected from the partition walls). To maintain the illumination the wattage per floor area must therefore be increased as the number of rooms in the same total floor area increases, that is as the size of the rooms decreases.

In practice the great majority of central-station managers who have chosen this system of rates have decided for the number-of-rooms in preference to the floor-area [26] basis, probably because the number of rooms is easier to determine than the floor area and the method of determination is easier understood by the average customer.

It is possible to combine the number-of-rooms principle to a certain degree with the floor-area principle by stipulating in a number-of-rooms rate that rooms with an area over a certain size count as two rooms [27] or that they count as many times as they exceed that maximum area.[28]

In at least one instance the floor-area principle is combined with the connected-load principle for determining the demand, in such a manner that the demand is rated as the connected load with the restriction that lighting equipment in excess of one watt per square foot of floor area is not considered.[29]

152. It has been shown above (Section 148) that, where the number of sockets is the basis of the rated demand the sockets in certain localities are not counted. In the same manner and for the same reason certain rooms—or their floor area, respectively—are exempted in the number-of-rooms and floor-area rates. We thus get "active" and "nonactive" rooms.

[23] Residence Lighting schedule of Pueblo, Colo.: The rated demand is the full connected load of lamps only.

Retail Lighting schedule of Washington, D. C. (includes all residence service): The rated demand is the full load, not counting small fans, heating and cooking appliances.

Residence Lighting schedule of Cincinnati: The demand is determined by inspection as 70% of the connected load. Small motors, heating devices and appliances for domestic use consuming less than 1 kw. are not figured in the demand.

Residence Lighting schedule of Cleveland: 17 watts for each outlet. Fans, heating and cooking appliances, charging sets and motors for domestic purposes not counted.

[24] General Lighting schedule of Saginaw, Mich.: Residence customers 80% of first 500 watts connected plus 60% excess. Appliances, such as electric ranges, ovens, etc., will be included at two-thirds of their maximum capacity, while other miscellaneous appliances are not included in determining the active load.

General Lighting schedule, Flint, Mich.: Residence customers full connected load. Electric ranges, ovens, etc., will be included at 75% of their maximum capacity. Other miscellaneous appliances not included.

[25] Cleveland, Ohio. See "Rate Research," Vol. VIII, page 179.

[26] For statistical figures see the end of Section 152.

[27] El Paso, Texas, 300 sq. ft.

[28] Superior Water, Light & Power Co., Superior, Wis., 300 sq. ft.

[29] Portland Railway, Light & Power Co., Portland, Ore.: Nor are heating, cooking and power appliances considered in this residence rate.

The definition of an active and a nonactive room is as a rule made by simply enumerating the different kinds of rooms which fall under one or the other or both classes. The rates of different companies differ from each other to a slight degree in that respect. Nonactive rooms are in all or almost all schedules: halls, bathrooms, basements, attics, closets, and porches. In several of the schedules we find further specified as inactive: The first three bedrooms, laundry, pantry, alcoves, garage, unfinished rooms, coal shed, storage rooms, etc. The real estate rating[30] or the architect's rating simply is made the criterion to distinguish the active from the nonactive rooms in isolated cases. The rooms of the first floor are rated differently in one case.[31]

The rates on the number-of-rooms principle and the floor-area principle have not yet found as wide an application in this country as they would deserve. An investigation (which does not claim completeness) showed 16 companies in the United States employing the number-of-rooms principle in 17 cities, and two companies only using the floor-area principle in three cities.

The number-of-rooms rates and the floor-area rates are almost exclusively designed on the principle of the so-called Wright demand rate or its modifications. Further discussion will therefore be put off until that principle has been explained (see Section 155 *et seq.*).

3. Description of the Various Rate Systems Based on Both Energy and Demand.

a. The Hopkinson Rate.

153. The simplest system of rates which embodies both an energy charge and a demand charge is the rate system which was devised by Dr. John Hopkinson in 1892. The customer's bill under the Hopkinson system consists of two separate portions, a demand charge and an energy charge. The demand charge is figured as the product of a certain fixed unit demand charge times the number of kilowatts (or horsepower or whatever unit has been chosen for the demand), and likewise the energy charge is the product of the unit charge times the number of kilowatt-hours consumed.[1] (It goes without saying that the energy charge is lower than it would be under a straight meter rate for the same service.)

The unit demand charge as well as the unit energy charge can be varied with increasing demand or energy, respectively, according to the block system ("demand block," "energy block" and "double block" systems), or according to the step system as shown for the pure meter rates in Sections 122 and 119.[2] "Demand block" and "demand step" systems with unchanged energy charges do not occur in practice as far as the author's knowledge goes.

b. The Doherty Rate.

154. This rate is an amplification of the Hopkinson rate by the addition of a customer charge.[3] It is named after Henry L. Doherty, the well-known New York engineer and financier who, to the author's best knowledge, introduced this system for the first time in Denver in the first decade of this century.

The Doherty rate can also be found in practice with a graduation of the energy charges.[4] Graduations of the demand charges by blocks or any graduations by steps are not found in practice with Doherty rates, as far as the author's knowledge goes.

c. The Wright Demand Rate (Multiple Rate).

155. This rate, which is one of the most generally used systems, has been designed by Arthur Wright, of Brighton, England, after whom it is generally called. Sometimes, especially if it embodies more than two steps, it is also called the "multiple rate."

This rate mentions only kilowatt-hour charges and yet, as will be demonstrated later (Sections 160, 161, 166 and 167) it embodies the equivalent of a demand charge and sometimes of a customer charge as well. A certain charge per kilowatt-hour ("primary charge") is made for the first block of kilowatt-hours of every customer; another one ("secondary charge") is made in the next block of kilowatt-hours, and so on, just like in the block meter rate, with this difference that the blocks are not determined by a certain fixed absolute number of kilowatt-hours but by some relation of the customer's kilowatt-hours to the customer's demand, in most cases as a certain fixed number per every kilowatt (or other unit) of demand. In other words, the blocks are not energy blocks, but generally load-factor blocks.[5]

Practically all the rates on the number-of-rooms or floor-area basis are Wright demand rates, either in the simple form just discussed that the number of kilowatt-hours in each block is proportional[6] to the

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[30] Minneapolis. (See "Rate Research," Vol. XI, page 164.)

[31] Pittsburgh. (In apartment houses bedrooms and bathrooms are counted as second-floor rooms, all other rooms and halls as first-floor rooms).

[1] Refrigerating rates of the Universal Electric & Gas Co., San Francisco: Demand charge $2 per hp. connected, plus an energy charge of 1 cent per kw-hr. Auxiliary service of the same company: Demand charge of $2.25 per kilowatt connected plus an energy charge of 2 cents per kw-hr.

[2] Energy Block System (demand charge unchanged):
Wholesale Lighting and Power, South Bend, Ind.:
Demand charge $1 per hp. connected, plus an energy charge of—
6 cents per kw-hr. for the first 50 kw-hr.
4 cents per kw-hr. for the next 50 kw-hr.
3 cents per kw-hr. for the next 100 kw-hr.
2.3 cents per kw-hr. for the next 300 kw-hr.
2 cents per kw-hr. for the next 500 kw-hr., etc.
Double Block System:
Wholesale Lighting and Power, High Tension, Boston:
Demand charge—
$60 per year per kw. for the first 15 kw. of demand.
$36 per year per kw. for the next 40 kw. of demand.
$30 per year per kw. for the next 100 kw. of demand.
Energy charge:
5 cents per kw-hr. for the first 1500 kw-hr.
3 cents per kw-hr. for the next 4000 kw-hr.
1.5 cents per kw-hr. for the next 50,000 kw-hr.
1.25 cents per kw-hr. for the next 50,000 kw-hr., etc.
Step System of Demand Charges and of Energy Charges:
Primary Power, Atlanta, Ga.:

Kw. demand	Demand charge.	Plus energy charge of
10 to 20	$1.70 net	0.9 cents per kw-hr. net
21 to 50	1.70 net	0.7 cents per kw-hr. net
51 to 100	1.60 net	0.6 cents per kw-hr. net
101 to 200	1.40 net	0.5 cents per kw-hr. net

Etc.

[3] Optional Lighting rate, Denver, Colo.:
Customer charge $9 per year, payable monthly
plus a demand charge of $1.80 per year per 16-cp. lamp of demand payable monthly (one-third of connected load)
plus an energy charge of 5 cents per kw-hr.
Wholesale Power, St. Joseph, Mo.:
Customer charge $100 per month.
plus a demand charge of 25 cents per hp. connected
plus an energy charge of 1 cent per kw-hr.
In this latter case the object of the customer charge is obviously to restrict the use of these cheap unit charges for demand and energy to the wholesale customer.

[4] Optional Commercial Lighting schedule of the Universal Electric & Gas Co., San Francisco:
Customer charge $10 per month
plus a demand charge of $1 per kw. maximum demand.
plus an energy charge of 1.5 cents per kw-hr. for the first 4000 kw-hr. and 1 cent per kw-hr. for the excess.

[5] General Lighting rates of Sioux City Service Co.:
12 cents per kw-hr. for the first 40 hours' use of the connected load
6 cents per kw-hr. for the excess.
General Lighting schedule, Portland Railway, Light & Power Co.:
9 cents per kw-hr. for the first 6% of the "monthly maximum consumption"
7 cents per kw-hr. for the next 6%
4 cents per kw-hr for the excess.
"Monthly maximum consumption" means the number of kilowatt-hours which would result from continuous use of the demand.

"demand" (number of rooms or number of square feet of floor area, respectively), or in some other more complicated form.[7] This latter form of rates will be discussed and analyzed later (Sections 161 and 167) and here will be mentioned only, anticipating this analysis, that it embodies the equivalent of a customer charge for certain customers.

A variety of the Wright system is based not on the block system of gradation, but on the step system;[8] such systems are exceptions, however.

What has been said before (Sections 119-121) about step meter rates applies also to step Wright rates, for instance that the steps can be formed by discounts, except that in this case the discounts are not quantity discounts but load-factor discounts.[9]

The Wright rate principle can also be applied to block or step meter rates.[10]

d. Combination Rates.

156. In this and similar ways a large number of combinations between the various systems of rates and various principles of rate-making[11] can be put into effect and a great variety of "combination rates" of this kind are found in practice. It is almost impossible and is of little purpose to enumerate or classify all these combination rate systems. Just to show the fertility of this field a few examples from practice will be quoted here at random:

1. The Retail Power schedule of Spokane is a combination of a Hopkinson and a Wright demand rate as follows:

Demand charge: $1.50 per kv-a. connected
plus an energy charge of
Nothing for first 20 hours' use of connected load
3 cents per kw-hr. for next 30 hours' use of connected load
1.5 cents per kw-hr. for next 50 hours' use of connected load
1 cent per kw-hr. for next 300 hours' use of connected load
0.5 cent per kw-hr. for excess.

We see, moreover, that in this particular Wright rate the unit energy charge is not steadily decreasing with increasing load-factors but that it first increases from zero to 3 cents per kw-hr. and then decreases by blocks. We might also look at it in this way that the Wright rate begins only at the load-factor or of 20 hours' use instead at the load-factor zero, as in all other Wright rates.

2. The General Power rate of the Great Western Power Co., of Sacramento, Cal., is a straight meter rate stepped according to the size of the demand (in connected load) as follows:

3.75 cents per kw-hr. under 10 hp. connected.
3 cents per kw-hr. from 10 to 50 hp.
2.5 cents per kw-hr. over 50 hp.

3. The Commercial Lighting schedule of Atlanta, Ga., is a combination of a step, block and Wright demand system as follows:

A. Demand 25 kw. or less:
Primary kw-hr. charge 7.77 cents per kw-hr.
Secondary kw-hr. charge, 6 cents per kw-hr.
Primary charge applies according to the following table:

Demand in 50-watt equivalents.	Primary charge applies to the following number of kw-hr.
1 to 50	150
51 to 60	175
61 to 70	200
71 to 75	225
76 to 85	250
etc.	

B. Demand 25 kw. to 50 kw.:
Primary kw-hr. charge, 7.77 cents per kw-hr.
Secondary kw-hr. charge, 6 cents per kw-hr.
Tertiary kw-hr. charge 4 cents per kw-hr.
The primary and the secondary charges apply according to the following table:

Demand in 50-watt equivalents.	Primary charge.	Secondary charge.
501-600	First 925 kw-hr.	Next 925 kw-hr.
601-700	First 945 kw-hr.	Next 945 kw-hr.
701-800	First 965 kw-hr.	Next 965 kw-hr.
801-900	First 985 kw-hr.	Next 985 kw-hr.
901-1000	First 1000 kw-hr.	Next 1000 kw-hr.

C. Demand above 50 kw.:
Primary kw-hr. charge 7.77 cents per kw-hr.
Secondary kw-hr. charge, 5 cents per kw-hr.
Tertiary kw-hr. charge 3 cents per kw-hr.
The primary charge applies for the first 20 hours' use of the connected load, the secondary for the next 20 hours' use and the tertiary, of course, for the excess. We see, therefore, that beginning from demands of 50 kw. we have a pure Wright demand rate, but not for demands below that amount.

Some of these rates require more or less study in order to arrive at a thorough understanding of their meaning. This study is very much simplified and the understanding of the various rate systems in general is made much easier by the systems of analysis explained in the following (Part IV), especially by the graphic system.

(To be continued.)

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[7] Optional Residence Lighting schedule, Oklahoma City, Okla.:
10 cents per kw-hr. for the first 5 kw-hr. per active room,
7 cents per kw-hr. for the next 5 kw-hr. per active room,
3 cents per kw-hr. for the excess.
Residence Lighting schedule of Tacoma, Wash.:
5 cents per kw-hr. for the first 40-watt-hours per sq. ft. active floor area,
1 cent per kw-hr. for the excess.

[7] Residence schedule of St. Louis, Mo.:
8 cents per kw-hr. for the first 4 kw-hr. for each of the first 4 active rooms, plus 2½ kw-hr. for each excess room,
6 cents per kw-hr. for excess up to 7 kw-hr. per room for all active rooms,
3 cents per kw-hr. for the excess.
This latter kind of Wright rate is not easy to understand for the beginner; the analysis of Sections 161 and 167 will explain it fully.

[8] Retail Power, Akron, O.:
5 cents per kw-hr. for 30 hours' use of the demand
4.4 cents per kw-hr. for 60 hours' use of the demand
3.9 cents per kw-hr. for 90 hours' use of the demand } 21 steps
..... etc. .....
1.5 cents per kw-hr. for 630 hours' use or over

[9] Wholesale Combined Light and Power rate of Dallas, Tex., (see next footnote).

[10] As, for instance, in the example of Dallas, Tex., where the rate is a step meter rate with a load-factor discount. This discount is given only, however, if the energy consumption is in excess of 50,000 kw-hr., which brings a further element into the rate.
Or, General Lighting rate, Northern Electric Co., Portland, Ore.: Primary rate covering the first 100 hours' use of the demand:

8 cents per kw-hr. for the first 10 kw-hr.
7 cents per kw-hr. for the next 70 kw-hr.
6 cents per kw-hr. for the next 100 kw-hr.
5 cents per kw-hr. for the next 720 kw-hr.
4 cents per kw-hr. for the next 1100 kw-hr.
3 cents per kw-hr. for the next 1500 kw-hr.
2.5 cents per kw-hr. for the excess.

Secondary rate covering the excess over 100 hours' use of the demand:

Demand 5 kw. or less.	3	cents per kw-hr. for next 1000 kw-hr.
	2	cents per kw-hr. for excess.
Demand 5 to 30 kw...	2	cents per kw-hr. for next 1500 kw-hr.
	1.5	cents per kw-hr. for excess.
..... etc.	.....	etc. .....

[11] Such as, for instance, changes of the unit prices by blocks or by steps, guarantees for a minimum bill or minimum demand or minimum consumption, discounts of various descriptions, such as quantity discounts, discounts for guaranteed bill, for guaranteed consumption, for guaranteed demand, for guaranteed term of contract (for instance, Lowell, Mass.), seasonal discounts, etc.

LYNN SECTION A. I. E. E. LEARNS ABOUT ATOMIC STRUCTURE.

In General Electric Hall, West Lynn, Mass., Dr. Saul Dushman, on Nov. 5, gave a lecture on "Structure of the Atom." Dr. Dushman, who is connected with the Research Laboratory of the General Electric Co. at Schenectady, N. Y., illustrated his address with lantern slides and a model.

SIGNALING SYSTEMS TO BE DISCUSSED.

A meeting of the Signaling Systems Committee, National Fire Protection Association, is scheduled for Nov. 18-20 at 141 Milk street, Boston, according to Chairman Ralph Sweetland. Proposed amendments to present regulations and other matters concerning signaling systems and fire hazards will be discussed.

Pulverized Coal Under Boilers

Relative Theoretical Performance of Stoker-Fired and Pulverized Coal—Comparative Costs—Abstract of A. S. M. E. Paper

By FREDERICK A. SCHEFFLER and H. G. BARNHURST

SINCE the purpose is to present the facts which indicate the coming general adoption of pulverized coal as a fuel for boilers, the discussion is presented in the form of a comparison with stoker firing, the latter being the most efficient method in general use for burning solid fuel under boilers.

The ultimate adoption of a new method depends entirely on its overall commercial efficiency. In the generation of power, overall efficiency may be considered as composed of the following factors: reliability, cost and adaptability. A method may acquire a wide field if it shows improvement in any one or two of these points. Improvement in all three points leads to the general superseding of other methods.

Comparison of Stoker with Pulverized-Fuel Plants.

Reliability.—Let us compare the reliability of a pulverized-coal installation with that of stokers. This factor depends on two items: Apparatus for preparing and presenting the fuel for combustion, and continuity of operation of the furnace itself. In a stoker installation the first of these includes the stoker itself. Neglecting the inherent defects of any system that presents a metal mechanism to the action of high temperatures, it may be admitted readily that the stoker system is satisfactorily reliable, with respect to its apparatus, for preparing and presenting the coal for combustion.

The corresponding mechanisms for pulverized fuel are equally reliable. This fact is proved by their widespread use for years in the cement industry and more recently in an ever-increasing variety of industries. It should be recognized that these mechanisms are not innovations, but are the result of years of development under operating conditions. Proper design of equipment by engineers of standing who are specialists in this line has made negligible the danger of dust explosions.

The second condition for reliability is the continuity of operation of the furnace. Here again we find an apparent balance between stoker and pulverized-fuel installations during operation. The advantage lies with pulverized fuel, however, for several reasons. The mechanism is altogether outside the furnace, hence cleaning and adjustment and the making of the few repairs required need not interrupt the operation of the boiler. In case of sudden necessity the fire may be ignited and quickly brought to full intensity, or it may be extinguished almost instantly. Greater uniformity of flame and temperature is conducive to longer life of the furnace lining in a properly designed furnace, and to the minimum variation in furnace efficiency. Finally, the pulverized-fuel installation relieves the power plant from dependence upon the availability of a certain grade of coal. Stokers will not handle all grades of coal.

Cost.—This second factor refers to the cost per B.t.u. delivered to the boiler. The various items entering into this cost by the stoker system comprise power, repairs and maintenance, labor, interest on investment, depreciation, insurance and taxes.

With pulverized-coal equipment the cost of fuel for the drier should be added to the preceding items. A moment's consideration will show that this item must be taken care of in the furnace of a stoker-fired boiler and that it is clearly cheaper to remove the excess moisture content from the coal in a drier, from which the gases leave at very low temperature, than in the furnace itself, where the evaporation of the moisture damps the fire, increases the content of inert gas and at the same time carries off a very perceptible amount of heat.

Returning to the balanced cost items, it appears that these show a saving in favor of pulverized fuel

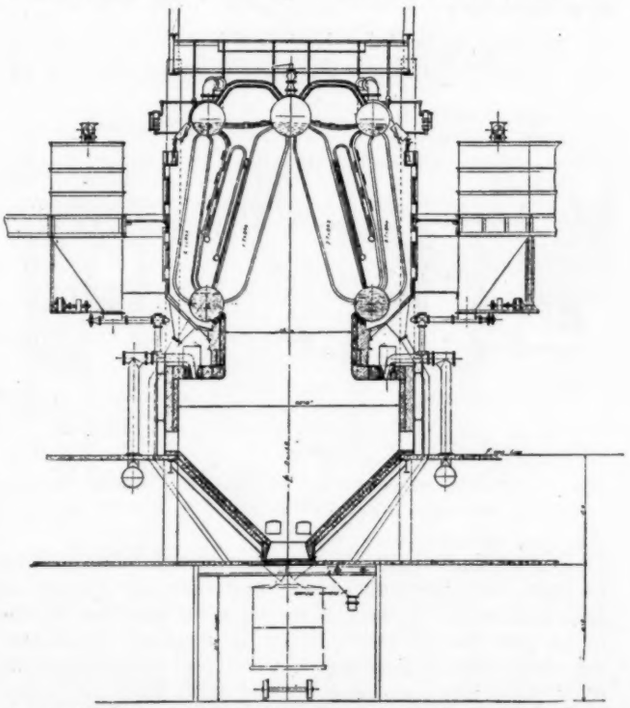


Fig. 1.—2400-Hp. Detroit Edison Type Boiler Arranged to Burn Pulverized Coal at 200% Rating.

in a large power plant and for the stoker in a small power plant. The figures in question are discussed further on in detail. It should be noted that when central pulverizing plants are built, they will relieve small power plants of the necessity for maintaining pulverizing equipment and make pulverized fuel considerably cheaper than stoker-fed fuel regardless of the size of installation. This feature is already being carried out successfully.

The final factor of the cost, furnace efficiency, which governs all the others, results in all respects to the advantage of pulverized fuel for the following reasons:

First: The fuel enters the combustion chamber in a finely divided state, being introduced with air at low pressure, and

is approximately perfectly mixed with the air for theoretically perfect combustion. Therefore no excess air is required for complete combustion. The units of heat taken up by heating excess air reduce the combined boiler and furnace efficiency. It is impossible to get a uniform fuel bed on a stoker or a grate and, therefore, impossible to approach complete combustion without introducing excess air. Should it be desired for other reasons to introduce excess air with pulverized fuel, it can be done in exact amounts, evenly distributed, without affecting the uniform nature of the flame and flue gases. This uniformity, which cannot be obtained in either grate or stoker installations, means maximum efficiency in all parts of the furnace and a maximum rate of heat transference to the boiler throughout its exposed area. It also means that flue-gas analysis gives an accurate determination of conditions in the furnace and that control of coal delivered and air supply can be adjusted with great accuracy.

Second: In pulverized form all of the combustible is burned, a consummation certainly impossible in lump-coal firing by either hand or stoker. It is not unusual to find 20 to 30% of carbon in ash refuse from grate or stoker-fired boilers.

Third: With pulverized fuel there are no standby losses with change of load or when shutting down, such as banked fires, etc.

Fourth: With properly designed pulverized-fuel apparatus nothing of a mechanical nature takes place in the furnace. In stoker and grate firing not only is the mixing with the air done in the furnace, but the presentation of fresh surfaces of combustible to the air supply must take place by the removal of the ash and its discharge through the grate bars, or the pressure must be great enough to force the air supply through the ash bed.

Adaptability.—Pulverized fuel is here pre-eminent. The primary feature is the possibility of burning all

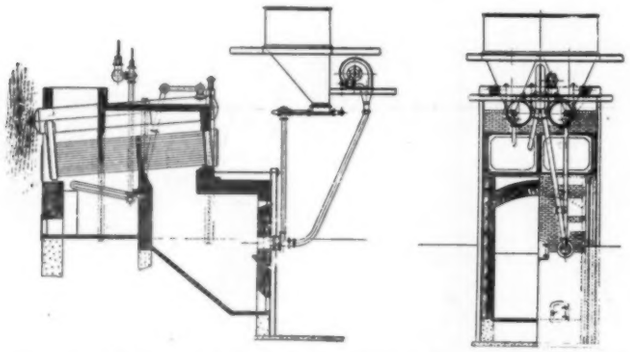


Fig. 2.—425-Hp. Heine Boiler Arranged for Pulverized-Coal Firing.

grades of fuel without affecting the efficiency of the furnace. To burn anthracite and very low grades of fuel requires a furnace allowing a return flow ot the flame past the incoming flame, to heat up the incoming fuel, and in furnace of this type fuel containing over 50% ash has been burned with high efficiency. The stoker is very much restricted in comparison.

The flexibility in the use of pulverized fuel is perfect, and the fire may be instantly adjusted to suit any condition of overload or lower load, including the cutting in and out of the boilers. The paramount importance of this feature and the utter impossibility of approaching it with stoker or grate firing is readily evident. Furthermore, the operation and the determination of conditions for complete combustion may be made automatic, the result being a smokeless and sootless boiler plant, which is essential in modern cities.

Furnace Design.—A few words on the design of furnaces for pulverized fuel may be of interest. The primary requisite for good results is to maintain low velocities in the furnace. The combustion is no less perfect with high velocities, but this will result in damage to the linings and in their erosion. A furnace cubical in shape usually gives the most satisfactory results.

The burners should inject the coal under low pressure and should permit of varying the density of the mixture in the burner itself. Their location and number will depend upon the size of the boiler and rating required, and also may be varied to suit the grade of fuel. High boiler ratings such as are used in modern boiler practice can be obtained when desired, and such overratings should be predetermined and the furnace volume designed accordingly.

It will be noted that pulverized coal behaves more nearly like liquid and gas fuels than it does like lump coal and that it is in the ideal state for burning with the highest possible efficiency. It has been shown that it is superior to lump coal as regards all three factors of overall efficiency and these statements are susceptible to proof upon investigation. The novelty of the pulverized-fuel plant is rapidly beginning to disappear, and on account of the fact that all obtainable coals are apparently becoming more inferior in quality, the interest in the use of pulverized fuel is very general throughout the United States and other countries.

In Table 1 will be found an itemized statement of the costs of pulverizing coal, and elsewhere some statements as to the cost of stoker operation for comparison purposes. Table 2 gives a list of boiler in-

TABLE 1—COST OF DELIVERING PULVERIZED FUEL TO BOILERS.

	100-ton plant, dollars per net ton.	1000-ton plant, dollars per net ton.
Power at ¾ ct. per kw-hr. and 17 kw-hrs. per net ton	$0.1275	$0.1275
Labor at 40 cts. per hr.	0.14	0.04
Drier coal at $5 per net ton delivered	0.06	0.06
Repairs	0.07	0.07
Total actual cost of pulverizing per net ton	$0.3975	$0.2975
Interest at 6%	0.105	0.039
Depreciation	0.12	0.04
Taxes and insurance	0.035	0.013
Total cost per net ton	$0.6575	$0.3895

stallations using pulverized coal and Table 3 reports of preliminary tests made on some of the pulverized-fuel installations now in operation. While these do not show the maximum efficiency to be expected with the further development of the art, they nevertheless indicate that the inherent difficulties have been solved and that at the present moment pulverized fuel is in a position to compete advantageously with any other method of burning solid fuel under boilers.

Comparison on an Efficiency Basis.

One of the most prominent engineers in this country, a member of the society, has stated that the combined boiler and furnace efficiency by the month, day in and day out, of a modern stoker-fired power plant with the best average plant operation is not better than from 63 to 65%, although a carefully conducted test on one boiler and furnace might show during several hours' run 75% efficiency. This statement has been confirmed by other engineers.

The results with pulverized fuel would be totally different. This is no apparent reason why a combined furnace and boiler efficiency of 75%, and even higher, could not be maintained throughout the year, as the operation of the plant would be practically equivalent to that of a fuel-oil installation, in which stand-by losses, banked fires, etc., are almost entirely eliminated. Unquestionably there should be a saving, under these circumstances, of 12 to 15% of the total coal consumption in favor of pulverized coal, and this reduction, on a basis of even a 2000-boiler-hp. plant,

will show a very fair return on the investment, neglecting the fact that a lower-grade and cheaper coal could be used.

Cost of Pulverizing Coal.

The cost of pulverizing the coal is of prime importance as low costs are essential for success and are achieved when the quantity used per day of 24 hours exceeds 100 tons. The cost of pulverizing is made up of a number of items as follows:

Power.—The power required is from 12 to 13 kw-hrs. per net ton of coal crushed, dried and pulverized. The additional power required for transferring the coal to the point of use and feeding it to the boilers will vary considerably, depending upon the distance transported, the size and number of the boilers, and the conditions under which they operate. The power required for this latter purpose varies between 4 and 6 kw-hrs. per net ton, so that the total power is 17 or 18 kw-hrs. per net ton. In the following paragraphs the cost of power has been assumed at ¾ ct. per kw-hr.

Repairs.—The item of repairs, including material, labor and general upkeep of the plant or maintenance, for the entire pulverizing plant and burning equipment will vary from 7 to 10 cts. per net ton of coal handled. The figures depend upon local conditions, and the size and general arrangement of the entire installation.

Drier Fuel.—The item of coal for drying depends directly upon the percentage of moisture and upon the price of coal. Ordinarily only from 1 to 1¼% of the total amount of coal used is required for drying. Assuming coal to have an average of 7% moisture as received and the cost to be $2.50 per net ton, the cost per net ton of drying the coal will be 3 cts. At $5 per net ton the cost of the drier coal will be 6 cts.

Labor.—This item is the greatest variable in connection with the pulverizing of coal, due to the increased output that can be obtained in larger plants per man employed. It is also subject to local rates of wages. For example, assuming labor at 40 cts. per hour, a plant of 100 tons daily capacity, properly designed and equipped, will require approximately 34 labor-hours to prepare the fuel and deliver it to the conveyors, whereas in a plant having a daily capacity of 1000 tons, approximately 115 labor-hours are required. Therefore the labor cost would be 14 cts. per net ton in a 100-ton plant, only 4 cts. per net ton in a 1000-ton plant, and as low as 2½ cts. per net ton in a plant of 5000 tons daily capacity.

Interest.—The interest item is based on 6% of the entire investment, and the cost of the pulverized-coal plant and burning equipment will of course vary considerably with the conditions under which the plant is installed. Roughly speaking, however, the actual investment will vary from $12.80 per kw. output in a 5000-kw. plant down to $4.80 per kw. in a 50,000-kw. plant and $4.12 in a 100,000-kw. plant (assuming a turbogenerator water rate of 16 lbs. and continuous boiler and furnace efficiency of 75%).

All these figures in relation to cost are based on the present high prices. The investment required for a 5000-kw. plant using 100 tons of pulverized coal daily is approximately $64,000 and for a 50,000-kw. plant using 1000 tons of pulverized coal daily, approximately $240,000, so that on a basis of 6%, and allowing for 365 days' continuous operation, the interest item will vary from 10½ cts. per net ton in a 100-ton plant down to 3.9 cts. per ton in a 1000-ton plant.

Depreciation.—Depreciation in a coal-pulverizing plant is usually calculated as follows: The life of the building is considered as 40 years, of the coal driers as 15 years and of the balance of the equipment as

TABLE 2—BOILER INSTALLATIONS USING PULVERIZING COAL

Date of installation.	Name of Company.	Location.	No. of boilers.	Horsepower rating and make of boilers.	Furnace design, per cent of rating.	Coal used.
Aug., 1916.	M., K. & T. R. R.	Parsons, Kan.	8	250 O'Brien	125-150	McAllister Cherokee slack, Kan. semi-anthracite. Texas lignites, San Bois coal, Oklahoma.
Nov., 1916.	American Locomotive Co.	Schenectady, N. Y.	1	300 Franklin	150	
June, 1918.	U. S. Verde Extension Mining Co.	Verde, Ariz.	2	439 Stirling	150	Gallup and semi-lignite.
Feb., 1918.	Ash Grove Lime & Cement Co.	Chanute, Kan.	1	371 Heine	150	Various grades of Kansas coals.
June, 1918.	Garfield Smelting Co.	Garfield, Utah	2	371 Stirling	150	Wyoming lignite, Wyopa, Wyoming lignite, Keystone, Utah, bituminous from various mines.
Nov., 1918.	Puget Sound Light and Power Co.	Seattle, Wash.	10	4-300 B. & W. 2-600 B. & W. 3-400 B. & W. 1-500 B. & W.	150	Renton buckwheat, Washington bituminous lignite and sub-bituminous.
Nov., 1917.	Sizer Forge Co.[1]	Buffalo, N. Y.	5	250 Rust	125	Pittsburgh and Pennsylvania.
Mar., 1919.	British Columbia Sugar Refinery Co.	Vancouver, B. C.	13	2-504 Badenhausen 2-250 B. & W. 9-110 HRT	150	Vancouver, B. C., bituminous and lignite.
July, 1918.	Milwaukee Electric Railway & Lighting Co.	Milwaukee, Wis.	5	468 Edge Moor	150	Indiana and Illinois bituminous, Pittsburgh and Youghiogheny.
Mar., 1919.	Allegheny Steel Co.	Allegheny, Pa.	1	333 Wickes	...	Pittsburgh coals.
June, 1919.	Inland Steel Co.	Chicago Heights, Ill.	1	250 Heine	150	Illinois bituminous.
June, 1918.	Pacific Coast Coal Co.	Seattle, Wash.	10 8	150 HRT 100 HRT	... ...	Renton buckwheat. Washington bituminous, lignite and sub-bituminous.
Nov., 1918.	Susquehanna Collieries Co.	Lykens, Pa.	1	250 B. & W.	200	All grades of anthracite washery culm, mine dirt, No 3 buckwheat, Lykens slush, Lytle slush.
June, 1919.	Lytle Coal Co.	Lytle, Pa.	6	333 B. & W.	200	All grades of anthracite, washery culm, Lytle slush.
May, 1919.	Garfield Smelting Co. (2d installation)	Garfield, Utah	4	371 Stirling	150	Wyoming lignite, Wyopa, Wyoming lignite, Keystone, Utah, bituminous from various mines.
Sept., 1918.	L. S. Smith Bldg.	Seattle, Wash.	2	1-300 B. & W. 1-200 B. & W.	... ...	Obtain and use coal from Pacific Coast Coal Co.
Sept., 1918.	Crystal Natatorium	Seattle, Wash.	2	72x18 HRT	...	Obtain and use coal from Pacific Coast Coal Co.
Sept., 1918.	Crystal Natatorium	Seattle, Wash.	2	72x18 HRT	...	Obtain and use coal from Pacific Coast Coal Co.
Sept., 1918.	Pacific Coast Coal Co.	Seattle, Wash.	12	2-250 Wickes 2-125 Ames (72x16) 6-125 Chandler & Taylor 2-125 Casey-Hedges	...	Obtain and use coal from Pacific Coast Coal Co.

[1]Also use some waste heat from pulverized-coal-fired furnaces.

TABLE 3.—REPORT OF PRELIMINARY TESTS MADE ON PULVERIZED-FUEL PLANTS.

Date of test.	Location of plant.	Duration, hrs.	Coal used.	Efficiency maintained, per cent.	B. t. u. per lb. of coal as fired.	Ash, per cent.	Rating, per cent.
Apr. 16, 1917	Seattle, Wash.	14.5	Renton buckwheat	77	10,000	11.60	122
Dec. 4, 1917	Chanute, Kan.	5	Kansas bituminous	72	11,996	17.7	125
Dec. 12, 1917	Chanute, Kan.	5	Kansas bituminous	83.94	12,500	18.25	125
Jan. 28, 1918	Chanute, Kan.	(25 days)	Kansas bituminous	78.1	11,435	.....	100
Apr. 26, 1918	Parsons, Kan.	6	Kansas bituminous	80.3	12,900	17.49	...
Apr. 28, 1918	Parsons, Kan.	6	Kansas bituminous	80.9	12,289	17.49	130.8
June 14, 1918	Milwaukee, Wis.	12	Illinois and Indiana screenings	83.3	10,897	15.89	117.7
Nov. 5, 1918	Lykens, Pa.	10	Lykens No. 3 buckwheat anthracite	84.2	12,530	16.92	135
Nov. 15, 1918	Lykens, Pa.	5	Lykens slush buckwheat anthracite	81.2	13,653	11.09	142
Nov. 22, 1918	Lykens, Pa.	5	Lykens slush buckwheat anthracite	85	12,753	18.04	146
Nov. 23, 1918	Lykens, Pa.	5	No. 3 buckwheat anthracite	72.7	12,530	16.91	115
Dec. 2, 1918	Lykens, Pa.	5	Lytle slush anthracite	75.3	15,420	23.92	188
Feb. 1, 1919	Seattle, Wash.	24	Issaquah screenings	78.95	11,660	14.31	126
Feb. 2, 1919	Lykens, Pa.	4	No. 3 buckwheat anthracite	78.9	13,067	14.02	177
Apr. 7, 1919	Vancouver, B. C.	4	Nanaimo slack	83.3	9,364	28.4	125
Apr. 17, 1919	Vancouver, B. C.	5	Nanaimo slack	77.1	10,050	24.3	160
Feb. 3, 1919	Lykens, Pa.	5.5	No. 3 buckwheat anthracite	78.9	12,530	14.00	...
Sept. 24, 1918	Verde, Ariz.	(6 days)	Gallup, New Mexico	79.5	10,680	14.31	155

20 years. With a 100-ton pulverized-coal plant and burning equipment the depreciation item will be approximately 12 cts. per net ton, and in a plant of 1000 tons daily capacity it will be approximately 4 cts. per net ton.

Taxes and Insurance.—Taxes and insurance are based on 2% of the entire investment and for a 100-ton plant this item is approximately 3½ cts. per ton and for a 1000-ton plant, 1.3 cts. per ton. Summarizing, the foregoing results show that the total cost of pulverizing and delivering pulverized coal to boilers is approximately as given in Table 1. The cost of the pulverizing equipment complete compares favorably with the stoker equipment when everything, such as coal and ash-conveying machinery, etc., is taken into consideration, and in large plants it is considerably less.

The equipment required for a first-class stoker installation must necessarily be taken into consideration when making a comparison of the costs of the different installations. The cost of pulverizing is an item of expense which must be included with the cost of the fuel, and since it includes the complete handling of the coal, the expense of crushing, handling, power, repairs, maintenance, interest, taxes and insurance covering the stoker equipment must also be considered when making comparisons.

Stoker installations and operation are expensive and the investment is as great, if not greater, than that required for a pulverizing equipment in plants of 10,000 kw. and upward. For example, in a plant using 1000 tons in 24 hours the cost of operation will be approximately as follows:

Power for stoker, 2% of the total boiler hp. developed	$180.00
Power for fans, 2% of the boiler hp. developed	180.00
Coal handling, 100 kws. at ¾ ct. per kw-hr	18.00
Labor for coal handling, 2 men per shift and 3 shifts at 40 cts. per hour	19.20
Repairs for stokers at 30 cts. per boiler hp. per annum	17.50
Repairs for coal-handling equipment	10.00
	$424.70
Total cost per net ton	$0.425

To this must also be added the cost of fuel used to heat the moisture in the coal, interest, depreciation,

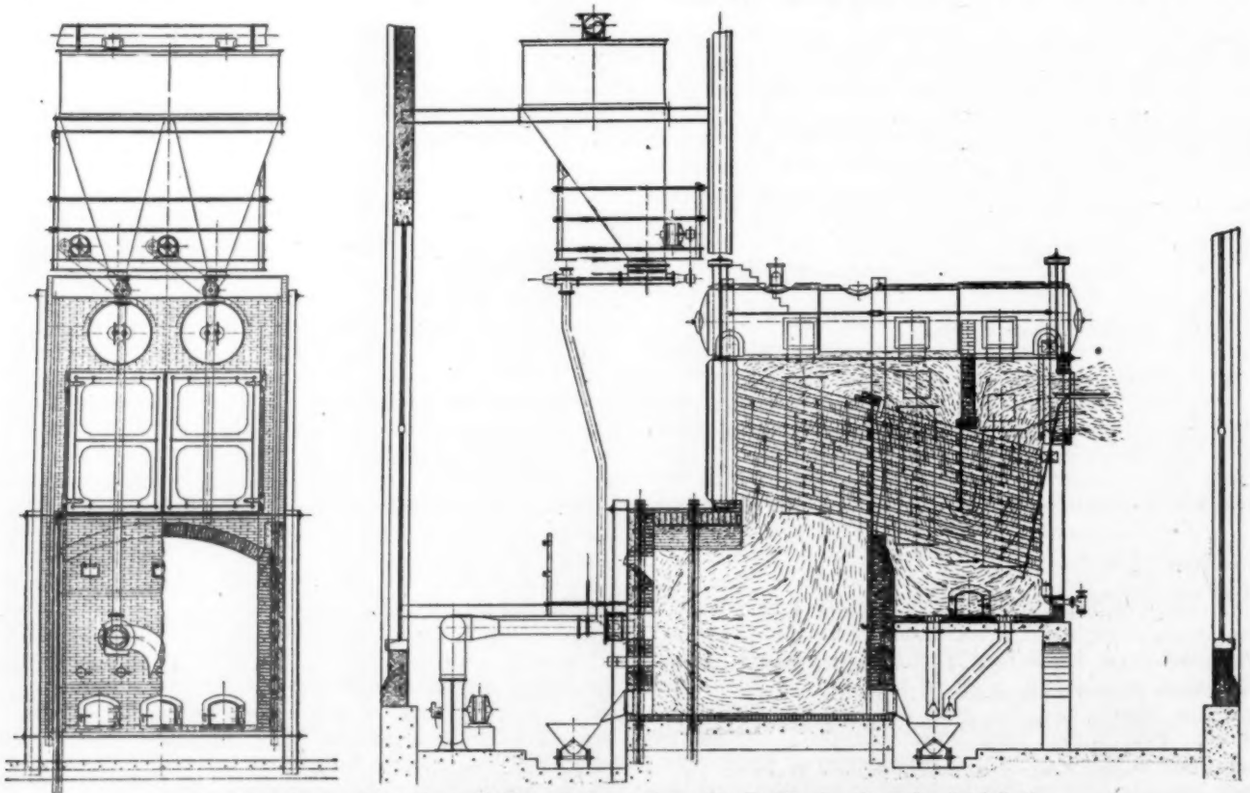


Fig. 3.—500-Hp. Babcock and Wilcox Boiler Arranged to Be Fired with Pulverized Coal.

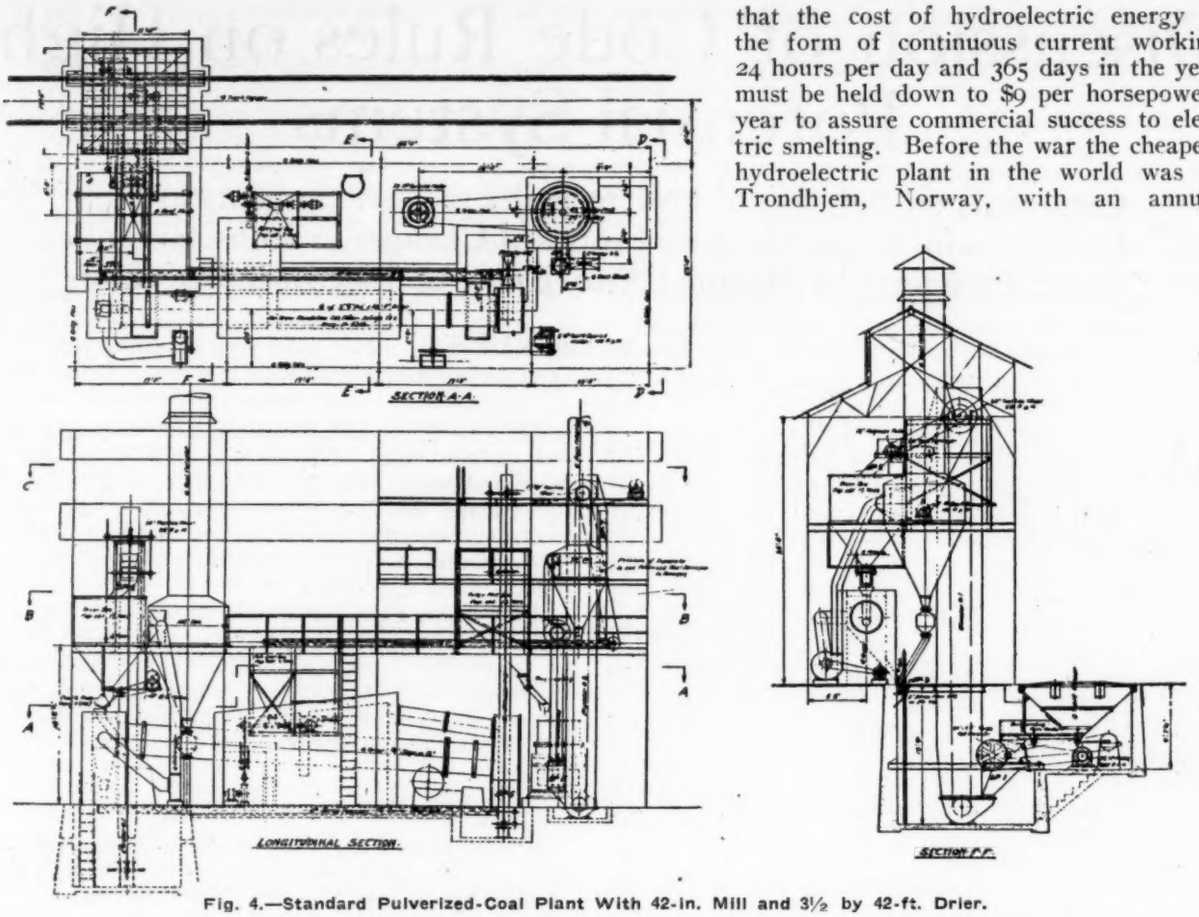


Fig. 4.—Standard Pulverized-Coal Plant With 42-in. Mill and 3½ by 42-ft. Drier.

insurance and taxes, showing that even on a basis of equal efficiency the cost of operating a pulverized-coal equipment is considerably less than the cost of operating an equivalent stoker installation. It should be stated that the figures just given are based on present average results in both cases.

NEW ELECTRIC IRON-ORE REDUCTION WORKS IN ITALY.

Hydroelectric Works Smelt Iron Ore Direct—Competitive Practicability Not Yet Assured.

The Ansaldo Co. has just started up its new 20-ton electric furnaces for smelting iron ore at Cogne, Val d'Aosta, in the northwestern corner of Italy, adjacent to the French and Swiss frontiers. The country is rugged in the extreme, with Mont Blanc towering in the near background. Considerable deposits of iron ore have been found, which in quality ranks with the best Swedish ore. Falling water capable to developing 80,000 hp. of electrical energy is near at hand. Conjunction of this latent electrical energy with native iron was hailed a few years ago as an epoch-making find for Italy. The Ansaldo Co., which undertook to develop the Italian ore deposits, after three years of preparation and the expenditure of an enormous sum, has actually begun to smelt iron ores in electric furnaces.

It is a question, says Commercial Attaché A. P. Dennis, of Rome, whether the venture will be successful. Can Italy turn out iron and steel in electric furnaces as cheaply as it can buy the material from Germany and the United States? An expert estimates that the cost of hydroelectric energy in the form of continuous current working 24 hours per day and 365 days in the year must be held down to $9 per horsepower-year to assure commercial success to electric smelting. Before the war the cheapest hydroelectric plant in the world was at Trondhjem, Norway, with an annual horsepower cost of $6. In Italy hydroelectric undertakings rarely run under $100 per horsepower for installation, which gives an interest charge of $6 to start with; adding to this $2 for amortization and $3 for overhead, we get $11 as the cost per horsepower-year.

It is stated on good authority that German pig iron is now being offered for Italian delivery at 40% lower cost than it can be produced in the new works.

It is suggested that the new electrical energy developed by the Ansaldo Co. at Cogne might be profitably conducted to the plains of Lombardy for the actuation of industrial plants and the electrification of steam railways. Undoubtedly the iron ore deposits in the Cogne region form no inconsiderable addition to the known wealth of Italy. These ores some day, when the prices of coal are lower than at present, may be transported on an easy down-grade haul to the port of Savona on the Gulf of Genoa for treatment with coal imported by sea.

PROPOSE POWERFUL WIRELESS STATION NEAR VANCOUVER.

Construction of a high-powered wireless station, which when completed will be the most powerful radio station in the British Empire, is proposed for the vicinity of Vancouver, B. C., by the Canadian Marconi Wireless Co.

The station, which will cost, it is estimated, in the neighborhood of $2,000,000, is designed to handle commercial business between Canada and the Orient, and a station of like power and cost will be built in Japan.

Discussion of Code Rules on High-Potential Systems

Comments on Relation of Present Rules to Developments in Field Practice, with Suggestions for Proposed Changes in Rules Given in Paper Presented to National Association of Electrical Inspectors

By G. S. LAWLER

Electrical Engineer, Associated Factory Mutual Fire Insurance Companies.

WHILE some manufacturing plants and large properties have been served with energy at high voltage for a number of years, the potential has been over 6600 volts in but few cases until comparatively recently. Within the last few years, however, the number of plants obtaining electrical energy from central stations has increased, this being due to the increased production of the factories having limited generating capacity and to coal shortage.

The amount of power purchased in the individual cases has generally become larger and the transmission voltages higher. Some manufacturing plants also generate and transmit large amounts of electric power at high voltages for their own use. The power involved in the supply required by a single manufacturing plant may be as great as many thousand kilowatts and the voltage as high as 150,000 volts. The greater the amount of power consumed the greater the tendency for high voltages.

Questions Involved on High-Potential Systems.

There are only a few rules in the National Electrical Code applying solely to high-voltage installations, and except for those covering constant-current systems and those pertaining to high-potential pole lines, the rules for voltages above 3500 are limited to the following: "Primary wires must not be brought into or over buildings except power stations and substations." There are also a few restrictions on the parts of an equipment supplied at low voltage through transformers connected to extra-high-potential lines.

Even though both the life and fire hazards increase with the voltage, there has never been any demand that the Code cover such equipment in detail. This has probably been due to the fact that the design, construction and installation of such equipment has been in the hands of those who usually understood all the factors entering into the varying problems. Engineers have been called upon to handle the installations and in order that the installations may be reliable from the standpoint of continuity of service they must also be reasonably safe from a fire standpoint. If the installation of high-voltage equipments was not generally in the hands of experts, it is probable that no amount of detailed Code rules would make them safe.

Owing to expediency, the need of keeping costs down and the desire to improve operating conditions, those responsible for the so-called extra-high-voltage installations may be inclined to slight certain features bearing on the fire hazard. To meet such situations the inspector should have sufficient engineering knowledge to say what should be done to correct the weakness under the particular conditions. In many ways it is better to have each case dealt with on its own merits with a few sound fundamental rules as a guide than to have rules which go into such detail that unwarranted inconvenience and hardship will result. The high-voltage installations must be safe, but no unnecessary obstacles should be put in their way, for they generally mean progress and are a real necessity under present conditions.

Except for 2300-volt motor installations and some occasional installations necessary in connection with the particular processes carried on, high-voltage equipments will be found in connection with power houses, substations, transmission lines, constant-current series lighting systems and transformer installations.

Fire Hazard in Power Stations.

Power houses and substations handling high voltages are usually operated by skilled men. This is especially true when they belong to public service companies and generally applies when they are under private control. The expert knowledge of the operators, combined with their natural desire to keep all apparatus in good condition and to have the property in their charge clean and neat, goes a long way to prevent serious fires occurring even when other conditions are adverse.

In modern noncombustible power houses and substations the danger from fire due to arcing between conductors removed from oil is reduced to a minimum, but in those of older design, where considerable woodwork is present, this must be considered, especially if the electrical equipment is of early design. It is not always feasible to change the arrangement in the older stations to remove this hazard, even though the management may fully recognize the desirability of improvement.

Another hazard of considerable importance is grouped combustible insulation on conductors. This may be corrected by putting the conductors in iron conduit, by ample spacing, or when this is impossible, by providing a noncombustible outer covering over the insulation of the separate cables or wires.

High voltages always mean the presence of apparatus containing oil. The higher the voltage and the greater the capacity of the apparatus the greater the amount of oil used. Some switches and circuit-breakers require several barrels of oil per tank, while large transformers may contain as much as 10,000 or 12,000 gals. of oil, the flash point of which may be as low as 300 deg. F. Under certain conditions the oil may be violently thrown from the apparatus and ignited. It is important that this apparatus be well chosen as to its capacity and suitably for the conditions to be met. It is also important that it be so installed that

fire at one piece of apparatus will damage as small an amount of other property as possible.

That the oil type circuit-breaker should have ample rupturing capacity is especially important. It frequently happens that the breakers may be all right in this regard when installed, but that increase of generating or transforming capacity has rendered them inadequate. It is not always possible to provide this capacity with the smaller breakers, but in such cases protection may be afforded by larger breakers between them and the source of power, and the time-limit attachments can be set with discretion. The use of suitable reactances may also be advisable.

Another piece of apparatus which may be a fire hazard is the aluminum type lightning arrester. So far as its functions are concerned it is effective, but due to one of several causes it may fail and it should therefore be separated from other apparatus so that if ignited oil is thrown from it the damage will be confined to the particular arrester where the trouble originated. These arresters should be installed outdoors, but if indoors they should be in separate noncombustible rooms or inclosures by themselves. If the arresters are large it may be advisable to drain the floors of the rooms. The new oxide-film arrester contains no oil and therefore is without oil hazard.

The hazard due to the oil-insulated transformers is sometimes disregarded by those responsible for their installation. Transformers installed indoors should be segregated and placed in proper noncombustible drained rooms or vaults cut off from adjoining rooms. A design of transformer has recently appeared on the market having entirely inclosed terminals and large overflow drain pipes. This type seems to possess considerable merit for installation where the primary voltages are high and the transformers must be located close to buildings.

Present substation practice tends toward installations of the outdoor type when sufficient space can be obtained. With these substations care should be taken that they are so located and arranged that danger to other property will be avoided. The ground should not grade in such a way that burning oil will tend to flow towards nearby buildings.

Fire Hazards Incident to High-Voltage Lines.

The principal fire hazards incident to high-voltage lines are, first, that they may fall on lower voltage lines entering buildings and start fires; second, the lines may break and fall on buildings if any are beneath; and third, if they pass near a building on fire, the fire may be poorly fought owing to the natural hesitation of firemen to use hose streams in the vicinity of the lines due to fear of receiving dangerous shocks. There is another hazard incident to long transmission lines, namely, the increased liability of trouble in the power houses due to lightning.

The first hazard is at present inadequately cared for in the Code, but is receiving attention. The Bureau of Standards has put a great deal of thought on it and has prepared comprehensive rules to guard against it.

The remedy for the second and third hazards is obviously to keep the lines away from important buildings. The Code requires that they keep off of buildings, but is somewhat remiss as to keeping them a sufficient distance from buildings. The minimum safe distance between lines and buildings depends upon the voltage, the height of the buildings, the value of the buildings, etc. Even though a certain distance may be safe, it may not be enough to allow firemen to work without fear; therefore the distance should be liberal.

Experiments made by Prof. F. C. Caldwell indicate there is no danger of shocks from a hose stream when the distance between nozzle and transmission line is more than 25 ft., irrespective of the voltage. At this distance from the nozzle the stream has apparently broken up into drops and the electric path has been interrupted. However, most of us would feel decidedly uneasy handling a hose line if the water could reach a high-voltage conductor even though we were sure the stream had become well broken up into drops.

While emergency switches may be installed on poles outside a property under consideration, they do not entirely eliminate the hazard, for when out of sight of the switches especially at night, fire fighters cannot be certain that the switches have been opened or remain open. There have been instances where a second person has closed an emergency switch, believing he was opening it, when the switch had already been opened. Again, there is the possibility that the presence of the switch may be entirely overlooked. The only safe way is to keep the lines away from property where serious fire is liable to occur so that all consideration of them may be eliminated.

The installation of high-voltage transmission lines with the necessary transformers also causes the well recognized hazard that, through leakage or breakdown of transformer insulation, high voltages may be impressed on low-voltage circuits. When the potential of the secondary circuit is below 150 or possibly 250 volts, the hazard may be guarded against by grounding the low-voltage side of the transformers. When the voltage is higher, grounding the circuits may cause more of a hazard than it prevents.

One way of partially guarding such circuits is to provide a substantial spark gap on the secondary side of the transformers, the gap being such that it will break down if the voltage increases much over the normal voltage of the circuit. Arcing across the gap may create such a disturbance that attention will be drawn to the conditions and cause the affected circuits to be opened. In the meantime the voltage on the secondaries will probably be prevented from increasing unduly. This arrangement may be somewhat crude, but it has its advantages.

The most common high-voltage installation in buildings other than power houses and substations is the 2300-volt motor equipment. Special needs in some instances may require high voltages and special apparatus, but these are relatively few and are special cases which may be dealt with on their merits.

Code Rules on High-Voltage Motors.

The sections in the Code applying especially to high-voltage motors and their wiring are few, but apparently they have met the needs of the situation in the past. In brief they require that there be no exposed high-voltage conductors or parts; all wires must be inclosed in iron conduit; junction boxes, cases, etc., and non-current-carrying metal inclosures must be thoroughly grounded; wires must be lead sheathed with suitable means of preventing entrance of moisture at the ends of the sheathing.

These requirements call for a high-grade installation. It is probably due to this and to capable maintenance that 2300-volt motor equipment has been so successfully used inside buildings where many nonelectrical persons are about. I have yet to learn of any fire caused by such equipment which can be attributed

to the high voltage *per se*, and can remember no case where a person has received a dangerous shock on the motor side of the distributing switchboard. Certainly the record of 2300-volt motor equipment is as good if not better than that of low-voltage equipments as regards fire and personal accidents.

In view of favorable experience with such equipment from the safety standpoint, it is now proposed to omit the requirement calling for the lead sheathing where no moisture is liable to be present, it being claimed that the lead sheathing does not contribute to safety in dry places. Assuming that the cable will not be subjected to moisture, there have heretofore been five possible advantages attributed to the lead sheathing.

First and most important, the sheathing may serve as a protection to life in that being a conductor it will bridge across any poor joint in the conduit system and insure that the portion of the conduit beyond the faulty joint will be effectually grounded. In other words, it is expected that the sheathing will serve as a bond between the various lengths of conduit, junction boxes, etc. If we could be sure that there were no poor joints between conduit, boxes, etc., there would be no need of the sheathing as a bonding medium. While all joints may be well made when the equipment is installed, there may be some question as to whether they will remain so indefinitely, especially when in buildings where there is a considerable amount of vibration.

Second, it has been claimed that the lead sheathing tends to protect the insulation over the conductors from mechanical injury while the cable is being drawn into the conduit. Injury to the insulation is more liable to give trouble than would be the case if the voltage was lower.

Third, owing to the metallic sheathing intimately surrounding the insulation on the conductors, it is nearer the conductors than the conduit wall except at one point, and therefore if a breakdown to ground occurs followed by arcing a short-circuit between phases is liable to occur quickly and cause the circuit-breaker protecting the faulty cable to open the circuit more promptly than if the sheathing was not present.

Fourth, another claim made for the sheathing is that it tends to prevent flattening out of the larger rubber-insulated cables, which results in the insulating wall between conductors and conduit decreasing in thickness.

Fifth, it has been claimed that the sheathing tends to preserve the insulation, especially when varnish cambric is used.

The weight to be put on the advantages claimed for the sheathing is problematical and the question is whether they are of sufficient importance to require the sheathing with the attendant increased cost of the installation. During the period when 2300-volt installations were being tried out, there is but little doubt that the increased cost was warranted. In view of the satisfactory results obtained, however, from the equipment, the question now is whether the increased cost due to the sheathing is justifiable. The second, third, fourth and fifth advantages claimed are of minor importance and should not be considered except in connection with the first. From the standpoint of fire hazard it is possible that the sheathing could be left off in dry places without unduly increasing the hazard, but from a personal hazard standpoint there may be objection.

The Code at present requires rubber insulation on 2300-volt conductors, but there have been many installations put in where varnished cambric was used. This kind of insulation has been used to a large extent in power houses, etc., where high voltages were involved. The experience has been uniformly good even in places where the requirements are most exacting. While there may have been some failures, these have not been more than would have been expected if the insulation were of rubber. There is now a demand that the Code recognize and permit the use of this insulation and there seems to be justice in this.

Discussion on Change in Code Limit for High-Potential Systems.

Another matter now under consideration involving a possible change in the Code is whether 4150-volt Y-connected systems have a sufficiently greater hazard than 2400-volt delta-connected systems to require them to fall under different classes of the Code. Many systems have started out 2400-volt delta-connected and then to meet the needs of increased load have been changed to 4150-volt Y-connected. The change has put them in the extra-high-potential class, and therefore the Code requires that they be kept off from buildings and that certain other precautions be taken. The limitation of 3500 volts for the high-potential class has been used for many years. When this was first decided upon, electrical apparatus and insulation were undoubtedly inferior to that of today, so that it is possible that this limitation may be moved higher without unduly increasing the hazard. If the voltage limitation under discussion is increased, it may be wise to limit the voltage which may be used at motors scattered throughout buildings and accessible to anyone, to that at present permissible, namely 3500, but practically 2300 volts.

Possibly another change which might be made to advantage in the Code would be to make provision for allowing cables carrying voltages up to the limit now permissible to enter noncombustible transformer buildings or vaults located in the midst of a group of buildings, provided the cables were run underground the entire distance between property line and transformer building. Again why not, under favorable conditions, permit motors of voltage up to, say, 13,000, to be installed in separate noncombustible rooms accessible only to the electrician, provided the high-voltage cables are in underground conduit just as mentioned in the case of the lines to transformers?

It seems that the demand for high-potential equipment in and about buildings is sure to increase under certain conditions, and the Code should be in such shape that they will not be discouraged when the conditions are favorable. It is hardly necessary for the Code to go into detail regarding such equipments. Broad fundamental rules, together with good judgment on the part of the inspectors, are all that are needed.

NEED OF ELECTRICAL GOODS IN RUSSIA.

At the weekly meeting of the Electric Club of Chicago, held Nov. 11, Marcus Stowe Hill, who has been in Russia for two years on export work, addressed the members, telling them of industrial conditions in that country. He said Russia was five years in arrears on imports and he showed by inquiries the large demand for electrical material of all kinds. Valuable suggestions for methods of making quotations and handling shipments were also given.

POWER PRODUCTION OF COUNTRY DURING FEBRUARY TO APRIL.

Division of Power Resources, United States Geological Survey, Issues Report on Power Production by Fuels and Water Power.

Continuing a practice inaugurated a few months ago, the United States Geological Survey, through its Division on Power Resources, has compiled the accompanying data on the production of electric power and the consumption of fuel by public utility power plants in the United States for the month of April, 1919. The figures as given are tabulated alongside the corresponding data for February and March for ready comparison. Table I gives the power production in thousands of kilowatt-hours segregated as to production by water power and by fuels. Table II gives the details of the latter classified as to the three principal kinds of fuel and amounts thereof.

The reports of electric power output and fuel consumption for February, March, and April are based on returns received from about 3100 electric power plants engaged in public service, including central stations, electric railways, and certain other plants, the output of which contributes to the public supply. Returns were received from plants whose aggregate capacity is about 90% of the generating capacity of all public utility plants. Estimates of the output of plants which did not make returns were made from available information. The total "estimated" power is only about 7% of each monthly total. The average daily output in kilowatt-hours for the different months is as follows: February, 106,540,000; March,

TABLE I—THOUSANDS OF KILOWATT-HOURS PRODUCED

State.	By Water Power			By Fuels		
	February.	March.	April.	February.	March.	April.
Ala.	39,341	30,275	28,488	11,059	4,907	4,477
Ariz.	3,967	6,689	7,577	17,448	21,807	16,488
Ark.	79	72	69	6,252	6,625	6,030
Calif.	187,486	215,914	227,775	38,268	33,939	33,645
Colo.	13,141	14,254	15,019	17,279	17,144	14,365
Conn.	7,043	14,884	15,804	42,589	37,469	35,525
Del.	.....	.....	.....	5,551	4,784	4,655
D. of C.	.....	.....	.....	18,094	19,331	18,457
Fla.	678	892	777	8,582	8,789	7,776
Ga.	35,909	37,264	31,404	6,054	6,082	6,200
Idaho	41,430	39,913	36,019	168	257	155
Ill.	15,611	15,282	16,134	198,899	207,673	194,109
Ind.	3,682	3,654	3,511	52,342	54,617	51,980
Iowa	44,182	48,696	48,737	23,993	24,964	23,646
Kans.	1,267	1,223	913	29,619	30,458	30,870
Ky.	4	4	4	18,794	19,127	18,555
La.	.....	.....	.....	14,130	14,876	14,582
Maine	18,831	20,157	18,708	73	73	93
Md.	284	371	358	18,435	13,898	11,442
Mass.	18,898	31,365	32,322	101,799	100,030	90,601
Mich.	52,236	59,649	65,211	97,285	96,125	88,363
Minn.	18,303	32,740	43,204	26,826	15,220	7,261
Miss.	.....	.....	.....	5,115	5,393	4,927
Mo.	4,297	5,920	4,418	37,207	40,551	36,245
Mont.	68,408	77,869	77,853	883	888	821
Nebr.	748	959	1,118	15,493	16,413	16,004
Nevada	3,198	2,812	2,470	137	121	727
N. H.	4,946	5,763	5,683	2,309	2,114	1,898
N. J.	162	197	187	75,665	76,412	76,642
N. Mex.	57	57	86	1,416	1,556	1,455
N. Y.	195,219	223,078	220,667	288,271	288,537	270,644
N. C.	42,645	46,318	45,755	7,149	7,426	7,082
N. Dak.	.....	.....	.....	2,312	2,400	2,103
Ohio	3,053	3,932	3,565	189,041	194,937	183,702
Okla.	167	183	149	13,080	13,796	12,989
Oregon	27,876	29,113	27,248	4,754	3,759	3,539
Pa.	55,098	62,509	58,466	238,970	246,930	233,597
R. I.	562	1,042	726	28,767	18,405	16,839
S. C.	43,899	43,394	43,287	3,876	4,010	3,676
S. Dak.	2,682	3,579	4,104	2,949	3,208	1,920
Tenn.	43,640	45,222	37,999	9,774	10,680	10,405
Texas	266	284	305	43,070	47,616	44,816
Utah	13,135	15,463	17,434	.....	.....	.....
Vermont	13,428	18,574	19,482	173	179	187
Virginia	17,833	20,122	19,298	17,254	18,709	16,539
Wash.	70,779	79,346	74,575	4,171	4,521	4,164
West Va.	1,378	1,593	1,642	52,620	58,108	59,396
Wis.	32,534	47,531	48,880	32,916	33,075	24,682
Wyo.	248	172	138	3,580	3,898	3,514
Totals	1,148,634	1,308,329	1,308,573	1,834,487	1,841,837	1,717,778
Total, by water power and fuels				2,983,121	3,150,166	3,026,361

TABLE II—FUELS REQUIRED FOR POWER PRODUCTION.

State.	Coal—Short tons			Petroleum and derivatives, barrels			Natural gas Thousands of cu. ft.		
	February.	March.	April.	February.	March.	April.	February.	March.	April.
Alabama	27,026	16,467	14,836	8	8	8	.....	.....	.....
Arizona	6,316	6,160	5,360	124,520	88,011	65,824	.....	.....	.....
Arkansas	13,386	11,177	9,902	447	489	456	63,430	85,398	97,726
California	.....	.....	.....	199,388	185,127	161,651	21,611	181,785	273,642
Colorado	41,507	44,079	36,135	100	95	98	.....	.....	.....
Connecticut	63,942	62,234	58,094	333	323	279	*20,766	*12,615	*11,309
Delaware	8,610	7,713	7,000	.....	17	.....	.....	.....	.....
District of Columbia	21,418	21,440	20,983	.....	.....	.....	.....	.....	.....
Florida	3,424	5,594	3,056	32,714	32,025	28,785	98	151	3,780
Georgia	16,529	11,934	12,009	120	120	167	.....	.....	.....
Idaho	120	111	121	10	10	10	.....	.....	.....
Illinois	335,309	350,824	318,378	3,918	3,198	2,142	.....	.....	.....
Indiana	141,060	157,931	143,829	448	167	420	2,159	2,108	1,909
Iowa	85,745	79,694	72,211	787	730	743	.....	.....	.....
Kansas	47,588	51,022	48,636	47,747	60,803	58,432	83,405	86,901	65,374
Kentucky	38,252	39,386	37,380	358	351	353	.....	.....	.....
Louisiana	14,305	13,885	13,878	30,811	30,094	28,192	55,092	47,458	49,599
Maine	383	348	357	7	7	17	.....	.....	.....
Maryland	28,452	23,657	20,755	19	18	30	1,500	1,500	1,500
Massachusetts	129,171	143,525	129,877	24	14	17	.....	.....	.....
Michigan	129,417	124,941	113,623	191	104	139	.....	.....	.....
Minnesota	57,282	39,810	25,038	1,138	1,016	854	.....	.....	.....
Mississippi	16,381	16,542	16,008	370	320	311	.....	.....	.....
Missouri	86,645	89,531	82,143	33,571	21,053	19,519	.....	.....	.....
Montana	5,537	5,591	5,455	530	492	488	1,008	960	907
Nebraska	29,946	30,956	29,813	3,512	3,509	3,433	.....	.....	.....
Nevada	198	180	140	900	1,044	997	.....	.....	.....
New Hampshire	5,395	3,911	3,241	20	20	3	.....	.....	.....
New Jersey	112,366	115,711	114,137	92	103	80	.....	.....	.....
New Mexico	4,045	4,438	3,627	1,060	1,360	1,373	.....	.....	.....
New York	368,569	363,338	325,474	544	546	501	149,831	164,408	164,956
North Carolina	15,648	16,234	15,612	20	20	20	.....	.....	.....
North Dakota	16,638	17,153	14,473	539	514	8,085	.....	.....	.....
Ohio	314,873	321,643	289,610	739	842	764	250,488	323,320	333,684
Oklahoma	11,136	13,203	13,203	8,109	5,675	5,675	423,813	477,050	477,050
Oregon	223	433	223	27,684	19,459	15,456	.....	.....	.....
Pennsylvania	401,874	412,561	396,096	22	14	16	42,301	54,450	53,533
Rhode Island	29,692	22,024	20,819	.....	.....	.....	.....	.....	.....
South Carolina	9,844	9,540	8,811	78	82	93	.....	.....	.....
South Dakota	7,082	8,395	4,371	3,164	2,379	3,091	.....	.....	.....
Tennessee	23,726	28,724	24,710	86	84	81	.....	.....	.....
Texas	25,330	33,963	26,618	170,905	181,397	178,033	173,695	179,760	177,778
Utah	65	61	31	.....	.....	.....	.....	.....	.....
Vermont	542	412	246	2	2	2	.....	.....	.....
Virginia	29,127	31,444	28,453	122	153	52	.....	.....	.....
Washington	3,611	3,473	2,411	17,810	18,804	17,879	.....	.....	.....
West Virginia	62,459	70,717	69,426	52	58	52	118,029	142,688	180,069
Wisconsin	69,225	74,987	53,037	644	662	565	.....	.....	.....
Wyoming	12,450	13,384	12,242	8,470	9,062	8,840	16,294	18,349	16,129
Totals	2,873,265	2,920,031	2,651,888	722,133	670,381	614,045	1,423,520	1,778,901	1,908,945

*Artificial gas.

101,620,000; April, 100,880,000. Amount produced by water power: February, 39%; March, 42%; and April, 43%.

In view of the temporary curtailment in the coal supply resulting from the strike of bituminous coal miners, it may be of interest to note the amount of coal required for operating public utilities in the United States. The average monthly consumption of coal by electric power plants engaged in public service for the three months covered by this report was 2,815,000 tons, or about 95,000 tons per day. This is equivalent each day to about 2100 carloads of 45 tons. The amount needed for electric public utility plants in New England, New York, Pennsylvania, and New Jersey is 36,900 tons per day, or about 820 carloads.

BRITISH ELECTRICAL INSPECTOR REPORTS ON FACTORIES AND ACCIDENTS.

Mr. Ram Reviews War-time Work and Practice in Central Stations and Factories.

G. S. Ram, the British Government electrical inspector of factories, has issued his report on the use of electricity in factories during the last four years of the war. His prewar reports will be recalled by our readers as forming instructive reviews of the technical and other defects, accidents, etc., that occurred in connection with factory and public electrical installations. The one now issued, though it has not reached former proportions, is a commendable attempt to resume normal publication and it contains a great deal of useful information. As we have already put before our readers particulars of the vast extension made during the war in the use of electricity in factories for munitions production, we need not deal with the sections relating to this matter excepting to note that in connection with the building and equipment of some of the new stations and supply extensions some very remarkable feats were accomplished under most trying conditions.

Mr. Ram briefly reviews the work performed by women as substitutes for men in central stations or electricity works and the efforts made to train and employ disabled soldiers and sailors. While the new generating station work is described as good, attention is directed to an important matter which was overlooked. In stations intended to maintain a continuous supply, night and day and Sundays, medium-pressure three-phase boards were so arranged as to make it impossible to carry out any work, e. g., overhaul of an oil switch, in safety. No isolating switches had been provided between the busbars and the oil switches and no divisions between the panels. This arrangement was found on the main switchboards where the supply had been at medium pressure and in high-pressure stations in regard to the medium-pressure auxiliary switchboards. These switchboards controlling all the auxiliary plant in the station are just as important as regards maintenance of the supply as the main switchboards.

The electrical work for explosives works and filling factories necessitated special precautions on account of explosive risks or liability of damage to wiring and apparatus from acid fumes. "Danger" buildings had wherever possible been lighted entirely from outside, and motors and all switchgear, fuses, etc., being either in separate buildings or in rooms completely shut off. In some the lighting was necessarily inside, special well-glass or bulkhead type of fittings being used. Motors, where inside, were pipe-ventilated or provided with forced draft ventilation with spray-washed air. In no case was any explosion or fire attributable, so far as could be ascertained, to any electrical installation or defect therein.

Several new steel rolling-mill installations had been put in, but the most striking development, says the inspector, has been that made in the application of the electric furnace in steel manufacture. In this connection the large currents required necessitate the provision of a transformer room as close as possible to the furnace. The main supply is in many cases at 11,000 volts. Unfortunately the equipment of the transformer house was in many instances carried out in a dangerous manner. The apparatus was often badly arranged and the protection of the high-tension conductors was totally inadequate, these being treated as of no more consequence than if at 100 volts.

In discussing the great increase in the use of electricity for welding during the war, Mr. Ram says that for resistance or contact welding there is of course no danger from handling the metal being welded at very low pressure, but there is danger in case of a breakdown of the insulation of the transformer causing the welding jaws and the metal being welded to become charged at the pressure of the supply circuit, generally 200 or 400 volts, and fatal accidents from electric shock have occurred in this way. The danger can be overcome by grounding one point of the secondary circuit. Mr. Ram found a number of welding machines in different works, notably for the welding of chains, where serious dangers existed through exposure of conductors, terminals, switches, etc., of the primary circuits. In regard to the use of screens to protect the eyes of operators in welding with metallic electrodes, he finds that masks or helmets are not liked by workmen, who prefer to use the hand screen wherever possible.

In the case of alternating-current welding it is very necessary that the electrode holder should be so constructed that it is impossible for the worker to touch any live part with his hand while holding the handle. Many electrode holders were found in use which did not comply with this elementary requirement. Another important point is that one pole of the circuit, that which is connected to the article to be welded, shall be efficiently grounded. Where this is done the only danger point, assuming that the flexible conductor is properly insulated and protected and the resistances, etc., are properly guarded, is the electrode holder and the electrode. There should, of course, be no switch or fuse in the grounded conductor. Except when the arc is actually maintained, the electrode is at the full pressure of the circuit. When the welding is done in a workshop, the welder is usually close to the switch controlling the circuit and can readily cut off the pressure when he has finished or when he requires to renew the electrode. In other cases he may be at a considerable distance from the switch and it may be inconvenient to get to it and he may put the electrode and holder down or hang it up and it will remain live and be a source of danger, or he may be tempted to renew the electrode while it is alive, a dangerous proceeding unless he is insulated from earth or wears insulating gloves. To get over this difficulty, says Mr. Ram, it has been suggested that there should be an auxiliary low-voltage circuit in the flexible cable, with a push-button thumb-switch in the handle of the electrode holder, arranged to operate a contactor switch at the fixed end of the circuit. The electrode and

holder would then normally be dead and would only be made alive when actually put to use.

Mr. Ram, in reviewing progress of the last few years in the science of illumination and the design of efficient fittings for factory lighting, said that in some of the new works he found some excellent examples of modern scientific lighting, but he also found in other cases instances of very bad lighting with gas-filled lamps which were unscreened and placed where they caused glare and harm to the eyesight of workers.

Except as regards districts in the United Kingdom which have been supplied for many years with direct current, the inspector says the development in the use of electrical power is mostly by alternating current, three phase or two phase, and from the point of view of electric shock risk at low voltage this is very much more dangerous if proper care is not taken. Mr. Ram found some good installations spoiled by not being properly finished off. The most prevalent fault in this connection was that even though the conductors were well protected in screwed steel conduits throughout almost their entire length, the conduit was not taken right up to switch boxes or motor terminal boxes, so that loops of unprotected cable were left, often in positions where liable to damage, e. g., on the floor at the motors. This was partly due to the slight extra cost of providing switch and fuse boxes and motor-terminal boxes having properly made sockets for the attachment of the conduit. Several large manufacturers supply their motors without any terminal boxes, cable tail ends being brought through the casing for connecting up to the circuit.

Owing to the great expansion in the use of electrical energy during the period under review it might have been expected that the number of electrical accidents would have increased. Mr. Ram says, however, that this was not the case. "The reduction in the number reported is so great that after making a liberal allowance for cases unreported owing to the stress of war conditions, it would appear to be a fact that the real number is considerably less than in the preceding period, and if the increase in the use of electrical energy is taken into consideration the proportion is very much reduced. New installation work has generally been found to comply with the regulations and the freedom from accidents is chiefly attributable to this cause. On the other hand, the number of fatal accidents has somewhat increased, 99 having been reported in the four years, 1915-18, as against 70 in the period 1911-1914. Of these 99 fatalities, 14 occurred in electrical stations of public supply or traction undertakings, the remainder on ordinary factory premises. In addition there were four fatalities indirectly due to electricity; one caused through explosion of gas from a secondary battery, by electric spark; one through failure of the current of a crane magnet allowing the load to fall on a man; one from burns where a girl got her dress set on fire by knocking the lead out of a terminal of a motor; and one from burns where a man short-circuited conductors with a benzine blowlamp; 95 out of the 99 fatalities occurred with alternating current, 19 being on systems of less than 250 volts, while 47 occurred on three-phase systems from 346 to 440 volts, but where the pressure to earth would not exceed about 250 volts, most of the systems having the neutral point grounded. Many of them occurred on lighting circuits taken from one phase and the neutral. In three or four cases only is it likely that the shock was received from contact with two of the phase conductors, the accidents being nearly all due to contact with one conductor only, the current passing through the victim to earth. Three direct-current cases were on medium-pressure traction systems having one pole grounded.

The inspector concludes his report with a reference to the importance of artificial respiration being applied in cases of electric shock. In three of the nonfatal accidents the victims were saved by this means.

TURBOELECTRIC SHIP PROPULSION AND ELECTRICALLY WELDED SHIPS.

Report by Lloyd's Register on Progress in These Lines in Great Britain.

"Lloyd's Register of Shipping" in its recent report upon its operations during the year 1918-1919 mentions that four vessels classed by the society were fitted with turboelectric propelling plant. The largest of these vessels, the *Wulsty Castle* of 3566 tons, was built in the United Kingdom and has a total shaft horsepower of 1500. The *Turbinia*, of 2259 tons, was built in Sweden and her engines have a shaft horsepower of 1020. Both these vessels were fitted with Ljungstrom turbines. Two smaller vessels were completed in America, the *Panoil* and the *Mexoil*, each of 1370 tons, the engines in each case having a total shaft horsepower of 820. These two vessels were fitted with Rateau turbines,

In referring to the use of electric welding for shipbuilding the report makes mention of the fact that in 1917 the committee arranged for an exhaustive series of tests to be carried out under the direction of the society's chief ship surveyor, to determine, as far as possible, the general trustworthiness of structural connections effected by electric welding and their capacity to withstand the strains to which they would be subjected. As a result provisional rules were adopted, as a tentative measure, for the classification in Lloyd's Register Book of vessels electrically welded, subject to the notations "experimental" and "electrically welded." The committee also formulated its requirements regarding the test to be complied with by all systems of electric welding for which approval was desired, and a notice was issued stating that the committee was prepared to consider applications from any electric welding companies, for their processes to be recognized by the society for use in ship construction and for their names to be inserted in the approved list.

Plans for the first vessel in which the butts, seams and other connections are to be electrically welded have been submitted and approved. This vessel, which is about 150 ft. in length, and in which the use of rivets will be entirely dispensed with, is now nearly ready for launching and the behavior of the vessel after completion will be carefully followed by all who are interested in the new system of construction. Applications have also been received by the committee for approval of a scheme of construction in which both riveting and welding processes shall be employed, but in such a manner that the vessel might be classed without the notation "experimental." After careful consideration the committee approved in the case of a vessel framed on the longitudinal system, a design in which electric welding will be employed in the construction of the bulkheads and for the attachment of the longitudinal frames to the structural plating, this approval being contingent upon a special notation being inserted against the vessel's name in the register book.

Editorial Comment

Shorter Working Day Means More Electrics

BRITISH electrical men who have been working hard for many years to boost the electric vehicles for public service in the big centers feel highly gratified at the large measure of success that has lately followed their efforts. Many towns and cities have placed orders for two to six electrics and in the aggregate the total is considerable, at any rate for England. It was expected that the end of the war would be followed by a big move forward as soon as vehicles became procurable, but the shortening of the working day has accelerated the rate of progress in one case already—that of Sheffield.

Here, consequent upon the introduction of the 47-hour week, reorganization of the entire city refuse removal service has had to be considered. Experience with 12 electrics during several years' working has been so satisfactory that 51 more are to be ordered and a new garage is to be built and equipped for their accommodation. The total outlay will be about $500,000, a figure far in excess of any other scheme yet carried out in England. It may reasonably be supposed that this will be a signal for a regular forward movement in other big towns which have already experimented with electrics for similar service.

Though new factories have been laid out for production of such vehicles during the war, and others are being erected, it is more than probable that British factories alone will not be able to cope with the requirements if the business grows rapidly, as it may do. American electric vehicle producers may well note this opportunity.

Charging for Estimating Expense

CONTRACTORS, as a general rule, conduct their businesses on a profitable basis, and their customers pay for the expense of preparing estimates, since a profit is made on the aggregate contracts. But this expense is not shared by all customers in proportion to amount of work done for each one, for which reason general opinion favors some plan to equitably apportion this expense.

A number of plans have been presented from time to time, but none of them have been considered thoroughly workable, so that little has been accomplished toward putting into practice a method of securing payment for estimating. Most of these plans have failed to make provision for paying the contractor for submitting estimates on work that does not go ahead. It often occurs that bids are asked just for the purpose of ascertaining what prices will be quoted. Then again, an entire set of estimates may be thrown out because the one calling for the bids may have set too low an amount as the maximum figure for the work to be done. Some plan should be devised whereby the contractor will receive compensation for all estimates prepared, so that the necessity for burdening contracts received with the cost of preparing estimates on work for which no contracts were received will be obviated.

A new plan which has come to our attention has several interesting features. It provides that an owner must stipulate that the work involved in the estimate shall not cost over a stated amount, and of this maximum cost a certain percentage would be set aside for division among the three or four lowest bidders. The size of the contract would determine the number of bidders who would be paid for estimating. Any bidder who could not get close enough to the lowest bid to be counted in would receive no pay, the inference being that his estimate was mostly guesswork.

While the plan is not complete these features seem worthy enough to be incorporated into a plan that would help solve this question of unfair practice.

Instruments in the Boiler Room

INSTRUMENTS are not installed in the boiler room to "show up" the boiler-room force. They are installed to assist the boiler-room crew in their work and thereby enable fuel and equipment to be used more economically and advantageously. Boiler-room instruments are a boon alike to their owner and to the user, saving money for the one and saving effort for the other.

The instruments of the boiler room, using the term instruments in its broadest sense to mean anything instrumental in obtaining efficient operation, may be divided into four classes, namely, those indicating totals, conditions, rates and relations. It is only when firemen know what they are doing and how they are doing it that they can work sensibly, obtain results economically and meet conditions as they arise by co-ordinating air and fuel with the demand for steam.

It is important to know how many pounds of water are being evaporated per pound of coal, per shift or per hour. But it is of more immediate concern to know the rate of steaming, told by the steam-flow meter, the rate of combustion as told by the tachometer on the stoker drive or the coal-weighing machine, and the rate of air supply as told by the draft gages. To work efficiently and successfully, one must know what is required to be done, whether it is being done and how it is being done. When these conditions obtain,

consuming fuel for raising steam no longer remains a hit or miss process but becomes an engineering function.

Knowing how something is being done without knowing what is actually being done is of little use. Only when the results are known and the manner of accomplishing them are also known can operating conditions be met and fulfilled efficiently. In other words, the boiler room needs instruments that record results and instruments that show conditions, and only when these are used can fuel be saved with certainty.

For showing quantity there are the ash and coal-weighing instruments; for measuring steam and water, steam-flow and water meters. For determining quality there are the coal calorimeter and moisture scales, feed-water thermometers and steam pressure gages and thermometers. For controlling and indicating conditions there are the familiar flow indicators, draft gages, thermometers and flue-gas analyzers. Each of these has its place and each is a good investment when properly used and intelligently applied. This means properly training the boiler-room force and offering sufficient incentives for them to do their best.

Coal is money today. Much of the waste that goes on would not be tolerated an instant longer if the quantity of coal consumed were converted to dollars and cents. Looked at from the aspect of money spent, coal-saving becomes something tangible, a financial matter of vital concern to the purchaser of coal. Considered in this light and remembering that the term "instrument" is used in its broadest sense to mean anything enabling a knowledge of operating and efficiency conditions to be known, that oft-asked question would not be "what are the fewest instruments I can do with?" but "which instruments can I afford to do without?"

Drawing Up Specifications

PURCHASE of materials or structures by specification safeguards the purchaser insofar as he knows with a certain degree of assurance that the material or structure purchased meets with those properties stipulated by him. Specifications safeguard the manufacturer in that if he meets the specifications he completes his part of the bargain, the onus for the wisdom and correctness of the specifications resting with him who specifies.

There is much to be said in favor of standardized specifications, although in this case as in all other cases, standardization has its drawbacks—drawbacks that are greatly lessened when standardization is sufficiently flexible to keep pace with progress. Standard specifications enable the producer to shape and make his product to the standard specifications, thus enabling specialization in comparatively few forms or types of product in contrast to many and varied types, as when every purchaser draws up his own specifications according to his own whim and ideas regardless of what others may be doing or have done. By so doing, the producer is handicapped, which reacts to increase the average cost of his products by limiting bulk production and all that goes with it. So, too, the purchaser is handicapped since his order may be classed as special, increasing the cost, adding to the delay in deliveries, and creating still further delay when the time comes for hurry-up repeat orders.

A specification is very largely a matter of viewpoint. It may, perhaps, be said that the specification having the greatest simplicity, the utmost brevity and sufficient completeness is the specification that meets the situation and fulfills best the need of the purchaser and the producer. In other words, a specification should stipulate what is necessary, what is fundamental, but should not deal needlessly with secondary factors not strictly germain to the condition to be met or the manner of meeting it.

A fact often overlooked is that purchase by specification may tend to add to the cost of the product, as when every purchaser draws up his own stipulations and specifications. On the other hand, standardized specifications tend to lower the purchase price because the one specification meets the need of many purchasers, hence calls for a standardized product instead of a special one. It may be pointed out, further, that the standardized specification tends to be the better all-round specification on the theory that two heads are better than one, and so several interested parties are ordinarily able together to create a broader and better specification than one party alone.

It used to be the fashion to specify voltage taps on all transformers regardless of whether there was any reasonable likelihood of using them. Better voltage regulation, appreciation that such taps cost money, cause complications and troubles, and the understanding of the fact that the cost of taps is investment wasted if the taps cannot be used, have done much to eliminate the stipulations for many needless and objectionable voltage taps on transformers. So, too, with insulation, specifications often call for the inclusion in the insulation of ingredients whose characteristics cannot be readily determined nor their presence proved. The only effect of such stipulations is to add to the cost of the product if bid upon by the conscientious bidder and offer opportunity for fraud on the part of the unscrupulous manufacturer. Specifications are of little use if no means is taken to determine whether the specifications are adhered to.

A specification should endeavor to stipulate such requirements as will enable a product to be obtained that will be able to meet its definitely prescribed function, and assure that quantities of the product will vary in uniformity only between clearly defined limits.

The specification that meets the situation best is the specification that is brief and to the point, yet is sufficiently complete without omitting any salient requirement. The thing is to say as little as feasible, not as much as possible.

Current Events

Commission Regulation Again Upheld — Illinois Utilities Begin Extensive Building—Tribute to William D. Weaver

STATE COMMISSION'S RIGHT TO RAISE FARES UPHELD.

Federal Supreme Court Says Utility Commissions Have Ample Right to Revise Franchise Rates.

The United States Supreme Court has dismissed the appeal of Kansas City municipal officials from the decree of the Missouri Supreme Court upholding orders of the Missouri Public Service Commission in increasing carfares in that city to six cents. In 1918 the Public Service Commission established the six-cent fare, although the franchise of the Kansas City Railways Co. provides for a five-cent fare without reservation or modifying clauses. The Missouri Supreme Court held that when the Legislature created the Public Service Commission, it restored to the State the power formerly vested in cities by charter to fix rates and public utility charges within the State. In its appeal to the Federal Supreme Court, the city argued that a contract franchise was sacred under all conditions and the State had no power to abrogate it.

PRESIDENT BALLARD OF N. E. L. A. BANQUETED ON RETURN HOME.

California Electrical Co-operative League Gives Dinner to Mr. Ballard for Bringing Big Convention to Southern California.

On Oct. 29 soon after his return home from an eastern trip of nearly two months in the interests of the National Electric Light Association, President R. H. Ballard of the association was given a banquet at the Hotel Alexandria in Los Angeles, Cal., by the electrical men of that city and surrounding cities. The dinner was given by the Electrical Co-operative League and was attended by a large number of the active electrical men from southern California, who wished to show their appreciation of Mr. Ballard's successful efforts to secure the next annual convention of the association for Pasadena on May 18 to 21.

A. Emory Wishon acted as toastmaster. Dr. John Willis Baer, of Pasadena, made a hearty address of welcome in which he spoke of the pleasure it will be to that particular city to have so great a gathering honor it next spring. He promised that nothing would be undone in the way of entertainment to make the stay of the guests from all over the country pleasant and memorable.

John B. Miller, chairman of the Southern California Edison Co., spoke of the change in attitude of eastern financiers and investors toward utility investments and other opportunities in California. William A. Brackenridge, president of the Southern California Edison Co., dwelt on the rapid progress in power transmission in California and how the achievements in this line are now being recognized throughout the country.

When Mr. Ballard responded he spoke especially of the opportunities that the convention will give to the utility men of the West in showing central-station men from all over the country the high state of development that has been attained. He said: "Two hundred and fifty million dollars can be used to advantage in electrical developments in California in the next ten years, half of which would be spent in the state for wages, raw materials and manufactured products. Large manufacturing industries would be attracted, thousands of acres of land irrigated, hundreds of thousands of homes electrically equipped from cellar to garret, making labor more productive and helping to solve the servant problem."

Others who spoke were Charles H. Pierson, E. O. Edgerton, chairman of the California Railroad Commission, John S. McGroarty, K. E. Kuran, committeeman of the California Co-operative Campaign, Glenn Arbogast, William H. Onken, Ben M. Maddox, E. B. Criddle and William Baurhyte.

BIG UTILITY BUILDING PROGRAM IS STARTED IN ILLINOIS.

Favorable Public Attitude Attracting Investors to State; Half Billion Dollar Expenditure Under Way.

High construction costs which now are 80 to 100% above the average of five years ago, are not to prove a bugaboo to public utility companies of Illinois. Believing that prices will not drop materially for some time, that the trend of general conditions is toward settlement and they have the substantial public sentiment of the state behind them, the companies are starting their after-the-war building program which in the aggregate calls for the expenditure of millions of dollars in developing the public service facilities.

According to the Illinois Committee on Public Utility Information, within the last month more new building projects have been reported as under way than in the full 18 months previous. This is directly attributed to the favorable public sentiment, which has not only given the industry confidence and the initiative to proceed, but is again giving investors the courage to invest their money within the state. The utility industry, as a whole, has plans laid for half a billion dollars of new work in the state in the coming five years. This is made possible by the growing confidence of investors who already have more than a billion dollars of their savings invested in the electric, gas, telephone and traction companies of the state.

"The greater understanding on the part of the public of the problems of the utility industry and the present generally favorable attitude is at the bottom of the determination of the managers of the properties to go ahead with construction," a prominent utility manager said. "Possessors of savings are free agents in the disposition of those savings, and they

will invest them only in those enterprises where a fair interest return is in prospect and where the safety of investment is assured. If Illinois did not provide sufficient inducement for the investment of the money here, it would simply be taken elsewhere and the state would lag in development.

"The move of the utility companies is bound to find reflection in all lines of business. The realization upon the part of the general public of the indispensable character of the utilities and their relationship to general prosperity and the fair treatment which all concede must be accorded them is going far towards encouraging investment. This investment must be heavy in order to overcome the halt in new building necessitated by the war."

TACOMA'S HYDROELECTRIC PROJECT AT LAKE CUSHMAN.

City Expects to Develop 75,000 Hp. by Damming Lake, Securing Large Reservoir and 580-Ft. Head.

The city of Tacoma, Wash., in its negotiations to acquire the Lake Cushman power site, will be ready to make plans for hydroelectric development there as soon as the former owners are in position to give a clear title thereto. Lake Cushman is an expansion of the Skokomish river, and the future plans contemplate the construction of a dam on the stream below the lake and thereby raising the water level of the lake about 60 ft. higher than the present level, and greatly increasing the capacity of the storage basin. Then, the plan is to convey water from a point above the dam through an open canal to a forebay from which it will be conducted through pipe lines and penstocks to the proposed power plant on Hood canal. This will give a head of about 580 ft. at the plant. Under this scheme it is expected to make possible the development of about 75,000 hp.

REPORT ON ELECTRIC POWER SUPPLY OF TWIN CITY UTILITIES.

Geological Survey's Report on Power Facilities of Minneapolis and St. Paul and How These May Be Improved.

During the war the United States Geological Survey co-operated with the United States Fuel Administration in studies and investigations undertaken for the conservation of coal. The possibilities of saving coal in different parts of the United States by interconnecting electric power systems, by substituting hydroelectric power for steam-generated power, and by closing down competing power plants in places where one power plant could better handle the total load were investigated at the request of the United States Fuel Administration by the engineers of the United States Geological Survey, Department of the Interior.

The public utilities in the cities of St. Paul and Minneapolis were investigated and a detailed report of their conditions was submitted Sept. 30, 1918, by the Survey to the United States Fuel Administration. This report was prepared by W. G. Hoyt, district engineer, United States Geological Survey, and F. W. Huels, engineer of the Wisconsin Railroad Commission.

The report describes the facilities for power production in the vicinity of St. Paul and Minneapolis, gives curves showing the power production of the operating companies and maps of power systems, states existing and prospective load conditions and gives load curves, shows existing interconnections and opportunities for additional interconnections, efficiency of power stations in utilization of fuel, utilization of water power, coal saving possible by further development and utilization of water power, possible increase of water power by developing water storage, coal consumption and cost, extent of power shortage, and use of exhaust steam for heating.

The report, which consists of about 120 typewritten pages and diagrams, will probably not be printed and thus is not available for general distribution, but it may be consulted at the office of the United States Geological Survey, Interior Department building, Washington, D. C., or at its district office, care of the Railroad Commission of Wisconsin, Madison, Wis.

NATIONAL SAFETY COUNCIL ESTABLISHES ENGINEERING SECTION.

Will Help Meet the Technical Demands of the Industrial Sections of the Council.

The formation of an engineering section of the National Safety Council has been authorized by the Executive Committee of the Council and the new section will be organized immediately by a special committee appointed for the purpose. In announcing this action, Sidney J. Williams, secretary and chief engineer of the National Safety Council, said the decision to form a distinct engineering section was prompted by three things:

First, the growing recognition of the imporance of the engineering factor in safety work;

Second, the growing interest in safety work on the part of civil, mechanical, electrical, mining and chemical engineers;

Third, the growing volume of experience and investigation in the engineering problems involved in safety work.

"The formation of an engineering section," Mr. Williams said, "will provide a vehicle for concentration of the engineering brains of the several thousand member companies of the Council on the solution of engineering problems affecting safety work in large groups of industries, in specific industries and in industry generally.

"The development of the Council has been largely along the lines of industrial sections. The Council now has 19 sections each with its own officers and program and each interested largely in the safety problem of its own particular field. These sections are as follows:

"Automotive, Cement, Chemical, Construction, Education, Electric Railway, Health Service, Marine and Navigation, Metals, Mining, Packers, Paper and Pulp, Public Safety, Public Utilities, Rubber, Steam Railroad, Textile, Women in Industry and Woodworking.

"The greatest contribution of the new engineering section will be with respect to problems that cut across the interests of several sections and affect whole groups of industries as, for instance, the hazards of poisonous dust or gas. The new engineering section will also facilitate contact and co-operation between the various national engineering societies, the engineering departments of the Government and the National Safety Council."

WILLIAM DIXON WEAVER.

Born August 30, 1857—Died November 2, 1919.

AN APPRECIATION BY WILLIAM E. KEILY.

"Engineer—journalist—scholar." These are the words descriptive of William D. Weaver on the memorial tablet placed in his honor in the rooms of the American Institute of Electrical Engineers. They are truthful characterizations, but it might be added that Dr. Weaver was not only an engineer but a man of the true scientific spirit; not only a journalist, but also a man of letters; and he was a scholar who possessed a warm human interest in the welfare of his fellowmen. Withal he was truly kind, sympathetic and companionable—one who "bore without abuse the grand old name of gentleman." He did much for electrical advancement, and all electrical men should hold his memory in honor.

For several years Dr. Weaver had been troubled by a weak heart, and he died suddenly at his home in Charlottesville, Va., early on the morning of Nov. 2. Dr. Carl Hering of Philadelphia, an old friend, was visiting at the hospitable Weaver homestead at the time. The man of the house seemed quite well on retiring. He died in his sleep. The funeral took place on the afternoon of Nov. 3.

Mr. Weaver was born on Aug. 30, 1857, at Greensburg, Pa., a city also noted in electrical history as the scene of the first or second commercial alternating-current system in the United States, established in 1886. After a year spent in preliminary study at the University of Kentucky he entered the United States Naval Academy at Annapolis, from which he graduated as cadet engineer in 1880. It may be remarked that only a few months ago Dr. Weaver received the honorary degree of LL.D. from the University of Kentucky. After graduation the young officer served in the Navy for twelve years except for one year's leave of absence in 1884, during which he studied electricity and conducted some investigations in the electrical laboratory of the Sorbonne, Paris, and the School of Electrical Engineering, London. In 1883 he accompanied, on the *U. S. S. Yantic,* the first expedition sent to the relief of Lieutenant Greely, the Arctic explorer. He was assistant engineer of the Navy on the *U. S. S. Omaha* which made a cruise of the world and spent two years in the waters around China, Japan and Korea. When he resigned from the Navy in 1892 he held the relative rank of ensign. While stationed at the New York Navy Yard he designed an electrical recorder which was largely used in speed trials and at launching of naval vessels. He also made other inventions, being resourceful in expedient. If he wanted to rebind his own books, he could do it, and one of the achievements of his later years was the preservation of the life of a prematurely born baby by means of an electric heating-pad incubator of his own devising.

After resigning from the Navy the young man had a year's experience with E. G. Bernard, of Troy, N. Y., in the manufacture of electrical appliances. Mr. Bernard died in 1915, and his former associate showed that he had not lost his business aptitude by winding up his deceased friend's affairs at that time. But it was as a technical editor, as a writer on engineering subjects, as a journalistic exponent of the science, art and industry of electricity, that Mr. Weaver found his life work.

He became editor of the *Electrical World* in 1893. In 1896 he enlisted the aid of James H. McGraw and established the *American Electrician* as a successor to *Electrical Industries,* a monthly originally established in Chicago in 1889. This new monthly magazine, with Mr. Weaver as editor, became notably successful. In 1899 the *Electrical World* and *Electrical Engineer,* weekly journals, were consolidated, and Mr. Weaver and T. C. Martin, the latter an able and experienced electrical journalist, became joint editors of the combined paper, which absorbed the *American Electrician* in 1906. In 1909 Mr. Martin became secretary of the National Electric Light Association, and thereafter Mr. Weaver was the sole editor of the *Electrical World* until May, 1912, when he retired, removing to Charlottesville, Va. The *Electrical World* has had many able men on its staff at various times, but it is perhaps fair to say that the editor who gave it the most distinctive impress of his individuality and to whom it was mostly indebted for its international standing as an electrical journal was W. D. Weaver.

Thus for nearly twenty years Mr. Weaver was prominent as an electrical editor. But he did many other things; he had much to do with the electrical advancement of his time, often remaining in the background, co-operating with others whose names appeared in connection with the work.

Always keenly interested in science, in engineering, in education and in literature, Mr. Weaver was a worker in the American Institute of Electrical Engineers for over thirty years. He became an associate as far back as 1887, when the society was only three years old. Later he became a member and still later a fellow. He served as manager for six years in two different periods. He was a member and afterward chairman of the committee which made the constitutional revision of 1900-1901. He always was opposed to the policy of allowing the society to be dominated by a small coterie of New Yorkers. On several occasions he was urged to become a candidate for the presidency, but such was his retiring disposition that he always refused, although he could probably have been nominated and elected.

In 1918 a group of friends and admirers, including Thomas A. Edison and Dr. C. P. Steinmetz, memorialized the president and directors of the American Institute of Electrical Engineers, requesting that a bronze tablet be placed in the headquarters of the Institute as a recognition of Mr. Weaver's services. This offer was accepted, and the tablet was unveiled on May 16, 1919. It bears a bas-relief portrait of Mr. Weaver and an inscription "To record his influence in the development and promotion of the art and science of electrical engineering." On that occasion Dr. A. E. Kennelly spoke briefly in appreciation of Mr. Weaver's efforts. He said the tablet was largely the result of the work of B. A. Behrend, and concluded by stating that the bronze portrait represented "the lineaments of a man who always thought of others and served others because he understood them." This memorial pleased Mr. Weaver greatly, but it is characteristic of his modesty that he should write, when the proposal was accepted by the directors, "I am still rather nervous over the affair, as it assigns to me a character to which I could not live up were I to have the longevity of a Methuselah." Alas, that was written less than a year and a half before the death of the recipient of this honor at the untimely age of sixty-two!

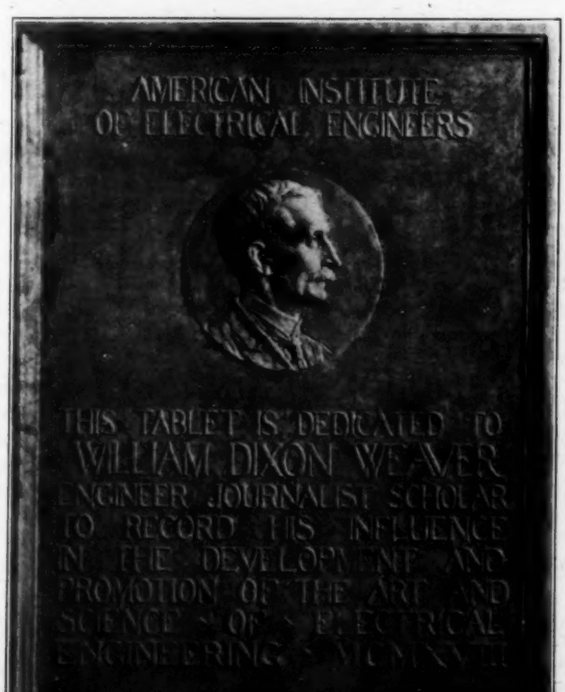
A great admirer of the clarity of the French intellect, of the beauty and precision of French literature and of French achievements in science, Mr. Weaver was nevertheless a thorough, ingrained American.

During the Spanish-American war of 1898 he served as volunteer chief engineer on the *U. S. S. Glacier*. In 1915, after his retirement, he was asked to become a member of the Naval Advisory Board but declined on account of his health. However, he was keenly interested in war work, and among other things he stimulated, by his vigorous articles in the daily press, and by other means, naval recruiting in Charlottesville and vicinity.

In 1900 he was appointed by the United States Government as an official delegate to the International Electrical Congress at Paris, but, upon his suggestion, the appointment was transferred to Dr. Kennelly. He had much to do with the St. Louis (1904) International Electrical Congress, of which he was treasurer and business manager. With Dr. Kennelly, who was general secretary, he supervised the publication of the Transactions of that Congress in three large volumes published in 1905. It is characteristic that this work bears the inscription: "Not copyrighted; publicity invited."

The engineering fraternity of New York City and vicinity is to a considerable extent indebted to Mr. Weaver for the Engineering Societies Building and the adjoining Engineers' Club. These fine structures were due to the generosity of the late Andrew Carnegie. A plan for a home for the engineering societies was submitted to Mr. Carnegie by Mr. Weaver as far back as 1895. Others made similar suggestions later, and it was in 1903 that Mr. Carnegie offered to give $1,000,000 for a suitable union building for all of the national engineering societies. A year later this gift was increased to $1,500,000, of which about one-third was for the Engineers' Club, the societies providing the land for the buildings.

Mr. Weaver was an excellent and discerning judge of engineering literature. He labored in season and out of season to build up the library of the American Institute of Electrical Engineers, which became a part of the engineering library in the Engineering Societies Building in New York. For several years he was chairman of the Library Committee of the Institute. He consulted with Andrew Carnegie and Dr. S. S. Wheeler in relation to the purchase of the large collection of electrical books and pamphlets made by Latimer Clark of London. In 1901 Dr. Wheeler purchased this library and presented it to the American Institute of Electrical Engineers. Mr. Carnegie donated the money to house, catalog and complete the collection. Thereafter, as a labor of love, Mr. Weaver, collaborating with the late Brother Potamian and others, prepared the elaborate "Catalogue of the Wheeler Gift" that, published in two volumes in 1909, stands as one of the monuments to his memory. By Dr. Wheeler's deed of gift it was provided that a copy of this catalog raissonné should be placed in the hands of every member of the Institute. These books are not only intrinsically valuable but are good examples of book making, for Mr. Weaver was a litterateur and bibliophile as well as a lover of science.



Memorial Tablet Erected in the Rooms of the American Institute of Electrical Engineers in Recognition of the Services of William D. Weaver.

In 1916 Mr. Weaver became interested in the possibility of securing the electrical library of the late Dr. S. P. Thompson of England for an American or Canadian college or library. However, the negotiations to this end fell through, although through no fault of Mr. Weaver. At one time there was a possibility that the John Crerar Library of Chicago would buy this collection, but finally, as the result of the efforts of British engineers, the library was retained in England.

The activities of this indefatigable man were not confined to one society. He had much to do with the organization of the Illuminating Engineering Society. Of this society as well as the American Electrochemical Society he was one of the founders. He served for three years as manager of the Illuminating Engineering Society and three years as manager of the American Electrochemical Society. He had also a great deal to do with the successful formation of the Commission on Resuscitation from Electric Shock, composed of representatives of several societies. He was a member of the Societé Internationale des Electriciens and had been honored by the French Government as an officer de l'Instruction Publique. Further, he was a member of the Naval and Military Order of the Spanish-American War, a member of the Sons of the American Revolution and an honorary member of the Philosophical Society of the University of Virginia. He was a member of the Engineers' Club of New York, the Army and Navy and Cosmos Clubs of Washington, the Country Club of Charlottesville and the Colonnade Club of the University of Virginia.

Always a scholar and an investigator, Mr. Weaver was familiar with college life in America and always a friend of technical schools and technical education. After his removal to Charlottesville in 1912 he became closely associated with members of the faculty of the University of Virginia, established at Charlottesville by Thomas Jefferson. It is reported that he was offered a place on the faculty of this university a few years ago. Some time before his death Mr. Weaver gave nearly his entire collection of technical books, including a number of complete sets of the transactions of societies, to the University of Virginia. Mr. Weaver was also a liberal donor of technical books to electrical societies.

A man of high ideals, Mr. Weaver felt strongly that cultural studies should not be neglected in tech-

nical education. "It seems to me," he wrote, "that technical engineers (as distinguished, say, from civil engineers) will some day have seriously to face the question whether they are members of a learned profession or merely followers of a technical vocation. In electrical engineering, for example, I have been shocked at the prevailing lack of pride in ancestry and interest in posterity—the only object of graduates being apparently to make a living or acquire riches from knowledge acquired with no recognition of those who in the past contributed to that knowledge, nor thought of making enduring offerings to the future in return for those received gratis from the past." He deplored a purely materialistic attitude in technical schools and thought that perhaps the reason that engineers are not accorded greater recognition in important public work is due to the opinion "that their vision is too narrow and their lack of touch with the human element in life has been too restricted to fit them to pass upon matters that must also be adapted to public policy and presented in such a form as most to assure favorable action from the public at large or from those who represent the public with full knowledge of how to placate its prejudices."

As may be judged from the above, Mr. Weaver always insisted on preserving his independence of mind. He himself said: "My name is probably more generally associated with the thought that I view things critically—though not necessarily in a hostile spirit—than with that of docility in acceptance of opinion backed by influential forces." Ordinarily the mildest and gentlest of men, he nevertheless was very tenacious in adhering to his opinions. On occasion he could express himself energetically, and he was a master of sarcasm if he desired to employ it.

He was a lover of books, both of the inside and outside of books. He was particularly interested in the French Revolution, and his collection of material relating to that period was probably excelled by few collections in the United States. He was a French scholar, reading that language with ease and speaking it well. He was, or at least was until recently, a member of three French societies for the rehabilitation of Robespierre, and in 1913 he was invited by a "maire" of one of the arrondissements of Paris to become an honorary member of a committee to forward a movement to erect a statute to Robespierre. The character of Robespierre was to him a fascinating study, and he returned to it again and again.

At one time he wrote about Paris: "I feel more at home in that city than in any other in the world, on account probably of my first impressions of the real world having been received there." He was a great admirer of Prof. André E. Blondel of Paris, who, he thought, possesses one of the finest intellects of the age. In recent years Mr. Weaver had given much study to the life and works of Thomas Jefferson. He was also an admirer of much in Russian literature.

An original thinker, a many-sided man, witty, not without his prejudices, and also, perhaps, not without a spice of malice occasionally, William Dixon Weaver was a brilliant, lovable man. He was steadfast to his friends and his kindness to them was unbounded. For young men and newcomers in the electrical field he always had a helping hand. He was an admirer of method, although those who worked in the office with him declared that he was not always methodical in doing his own editorial work. But nevertheless his was a charming personality. His home life was ideal. In 1900 he married Miss Mildred Niebuhr, and the union was blessed with six charming children. Mr. and Mrs. Weaver were most hospitable, and their home was characterized not only by books and objects of beauty and taste but also by a delightful spirit of comradeship, sprightliness and family affection. Retiring in disposition, with an acute distaste for public appearances, Mr. Weaver found his greatest joy at his own hearthside. In his later years he was able to obtain relief from the merciless daily grind of the editor's duties, applying himself thereafter to those intellectual diversions which were such a pleasure to him. From his library this brave, subtle, kindly spirit looked out on the world with the serenity of a philosopher and now, "Home is the sailor, home from sea."

NEW YORK STREET CAR COMPANIES DISINTEGRATING.

Federal Judge Julius Mayer signed an order recently directing the Brooklyn Rapid Transit Co., New York, that leases and operates several small traction lines as a single system, to return the property of the Brooklyn City Railroad Co. to its owners for independent operation. The reason for the order was the inability of the Brooklyn Rapid Transit Co. to pay $200,000 rental to the Brooklyn City Railroad Co. due on Oct. 1. The separation, which took effect at midnight, Oct. 18, results in considerable hardship to people who use the released line since, by eliminating transfers at 450 transfer points, users are required to pay two fares.

The failure of the Brooklyn Rapid Transit Co. to pay the rentals on its leased lines is caused by the general inability to operate on the 5-cent fare. Public Service Commissioner Lewis Nixon, after public hearings granted for the purpose of ascertaining the reasonableness of present rates and the increased rates petitioned for by the street railway companies, has permitted certain lines in Manhattan to institute a 2-cent charge for transfers and has authorized certain other lines to increase fares. The authorization has been suspended by a writ issued by the Supreme Court of New York prohibiting the Public Service Commissioner from acting on the application for an increase in fares because the franchise of the railway company specifically provided for a 5-cent fare.

The disintegration in the street railway systems is due to the general inadequacy of the fares being charged. Increases in fares have been prevented by the Hylan administration which contends that the railway companies should be compelled to perform their contract obligation to supply transportation for the nickel fare. Already several small lines have suspended operation. Relief for residents along these lines has been afforded by jitney buses. The relief is only partial, however, since they make no provision for transfers.

TRACTION EXPENSES STILL INCREASE.

In spite of the numerous fare increases granted during the last year, the latest figures show operating expenses of the electric railways increasing at a greater rate than revenues. Net income after payment of taxes and fixed charges was 1.54 cts., as compared with 2.23 cts. per car-mile in 1918, a falling off of 30.94%. The operating ratio in July, 1919, was 75.30, compared with 70.85% in July, 1918, an increase of 6.28%.

Commercial Practice

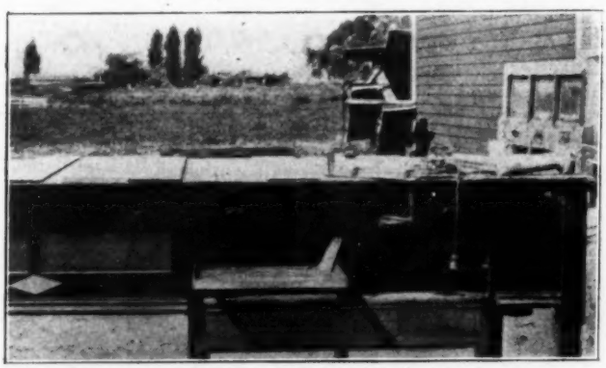
Successful Application of Electricity to Incubators—Electric Trucks in England—Surcharge for Power Service Approved

THE APPLICATION OF ELECTRIC HEAT TO INCUBATORS AND BROODERS.

Automatic Electric Incubator Proves Superior to Other Types Because of Economy and Safety Features—Description of California Installation.

Many methods of heating have been used in the past to hatch eggs, among them being the kerosene lamp, gas heater, solar heater and steam, but the only successful automatic incubator is that operated by electricity, with the possible exception of nature's method—the hen.

In the vicinity of Artesia, Calif., is located the largest electric hatchery in the world. This plant now has a capacity of approximately 100,000 eggs and a weekly output capacity of about 30,000 chicks. During seven months of the year this plant is working at



Close-up View of Electric Incubator.

full capacity most of the time and the annual output will average close to 750,000 chicks. It is here that the first successful electro-incubation was achieved, says P. J. Denninger in *Edison Current Topics*, the publication of the Southern California Edison Co.

Construction of the incubator itself need not be described because electric heat and control may be applied to any type of incubator. The electric heating unit consists of a cylindrical, grooved porcelain core, and in the groove is wound a resistance coil made of nichrome wire. The resistance coil being laid in a groove, makes the heater self-insulating and there is no danger of the coils coming in contact with the metal flue or any other cover with which it may be surrounded. The current-consuming capacity of each element is 600 watts. One element is used to an incubator and the brooders contain one or more elements depending upon the size and capacity of the brooder house.

The controlling device is unique in construction yet simple in operation and easily adjusted. It is a thermostat and known as the tandem wafer type. The wafer is composed of two brass disks soldered together and the air space between is filled with ether. To the center of the top wafer is attached a perpendicular control rod. This rod extends up through the framework and operates a horizontal control lever which is weighted at the opposite end from the control rod to give a positive and steady action. The lever is attached by means of a coil spring to a rocker-arm pivoted at the center of its length. It is this rocker-arm that makes the contact and opens or closes the circuit as the wafers expand or contract. The connection between the lever and the contact arm is made in such a manner that the arm will not move until there is a considerable tension on the spring and when it does move the action is positive and the opening or closing of the circuit instantaneous. In this way burning or fusing of the contact points is practically eliminated. The entire mechanism is operated by the contraction or expansion of the tandem wafer, the ether confined in the disks being so volatile that a slight variation in temperature will cause immediate contraction or expansion sufficient to move the control up or down, thus opening or closing the circuit.

An automatically heated brooder house has also been devised using the same heater and control to which has been added an alarm bell system which warns of any undue change of temperature.

Very attractive rate schedules have been established for this business although small installations can be operated profitably on the lighting schedule. Where consumers have the combination schedule for lighting and cooking, incubators can be added to the circuits without increasing the minimum, thus obtaining advantage of the cooking rate of 3.5 cents per kw-hr. The consumer who is operating a pumping plant may apply his pumping plant rate to the incubator and brooder load by increasing the minimum charge $1 per month or horsepower equivalent added in incubator or brooders. There has also been provided a schedule for the monthly minimum of $10 per month and the rate of 3 cents per kw-hr. which may be applied exclusively to electric incubation. The cost of operation depends a great deal on local conditions, but it is generally estimated at 1 cent per chick.

The advantages of electric incubation are many and such as to make this method far superior to any other. There is no danger of fire, no loss of chicks from chilling or overheating, no lamps to clean, fill and adjust, no gas burner to go out and asphyxiate the chicks with escaping gas. It is only necessary to push the button or turn the switch and then one can devote his time to other pursuits, as the automatic control needs little attention. All these advantages spell increased profits, not only from economy of operation, but by virtue of the uniform heat control more and better chicks are assured. With the perfection of electric hatching and brooding the hen is left free to devote her entire time to egg production and even here electricity is rendering aid by illuminating the coops and chicken yards, thus getting the hens on the job earlier in the day.

SHEFFIELD, ENGLAND, TO PLACE BIG ORDER FOR ELECTRICS.

$500,000 for 51 Electric Trucks for Refuse Removal, and for Electric Garage.

By far the most important move that has taken place in England in the adoption of electric vehicles for refuse removal is reported from Sheffield, where 51 vehicles of the kind are to be added to the 12 already in use and 3 on order, making a total of 66 for the whole city.

It is interesting to note that the establishment of the 47-hour working week led Cleansing Superintendent J. A. Priestley to report to the City Health Committee on the question of the future policy of the department in relation to the equipment needed for the collection and disposal of the house refuse.

The reorganization plans have had to take into account the fact that the alteration in hours will mean 8% reduction in the working time of the men and a corresponding decrease in the work accomplished is anticipated. This involves the necessity of adding to the equipment to the same extent in order to obtain equal results. During the war equipment could not be added to and the system at present does not give sufficient elasticity to deal with pressure or rush periods. The department must possess equipment to meet any emergency.

Mr. Priestley in his report, upon which the city has decided to take action, says:

"The experience of the past four years with electric motors has been eminently satisfactory and has demonstrated that the work can be done by their agency more expeditiously and economically than by horse labor. I am satisfied that for house-to-house collection work the electric vehicle cannot be approached by petrol (gasoline) motors. Steam wagons approach more nearly to electrics in suitability and economy for this work, but the latter possess advantages in noiselessness and ease of maneuvering that are not shared by steam wagons and require the services of one man only to drive them, and that not necessarily a skilled man. Since electric vehicles were introduced in Sheffield we have added to the fleet from time to time such a number of vehicles as would compensate for the wearing out of the horses engaged on refuse collection but no surplus vehicles have been obtained. With the conclusion of the war and the greater facility for obtaining delivery of motor vehicles, I think it is desirable that the policy of the department should now proceed on settled lines and that horses should be replaced as rapidly as possible by electric vehicles.

"The total weight of refuse collected in the city during the year ended March 25, 1919, was 110,855 tons which gives an average weekly collection of 2131 tons, but as the amount varies as between summer and winter the maximum amount to be collected during the heaviest period of the year may be taken at about 2600 tons weekly. To collect this quantity of refuse by electric vehicle will require about 60 electrics, or allowing a 10% margin to cover breakdowns, 66 vehicles would be necessary. We have at present 12 vehicles in use and 3 on order and the full program would therefore require the provision of 51 additional machines."

Garage accommodation is available for the existing vehicles and by conversion of stables not now fully occupied provision can be made for a small number of additional machines, but the garaging of 60 or 70 vehicles will necessitate the erection of a properly designed and equipped building for this purpose. For charging the batteries of this number of vehicles three 100-kw. motor-generators would be required in addition to the present charging facilities and as a standby machine is imperative four generator sets of this capacity must be provided. Charging panels, switchboards, measuring instruments, etc., will also be required in proportion to the vehicles and Mr. Priestley estimates that the total cost of the equipment as described would be about $500,000. The process of substitution is to proceed regularly and systematically and it will be spread over a number of years which, having regard to the age and condition of the major part of the stud of horses, should not be longer than six years.

COURT UPHOLDS RIGHT TO FIX POWER SERVICE RATES.

New Jersey Supreme Court Approves Surcharge for Power Service—Private Contracts Must Give Way to Public Welfare.

The State Supreme Court of New Jersey handed down a decision on Nov. 3 upholding the right of the Board of Public Utility Commissioners to allow an increase in the power rates of the Public Service Electric Co. The case in question was brought by the Edison Storage Battery Co., West Orange; Snead & Co., iron works, Jersey City; Crucible Steel Co., Harrison; Independent Lamp & Wire Co., Weehawken, and the Bound Brook Oilless Bearing Co., Bound Brook, these plaintiffs contesting the authority of the Commission to allow a 25% surcharge for power service to industrial consumers.

This order of the Board was made on July 16, 1918, and the rates allowed were to apply to electric energy supplied after Feb. 1, 1918, at which date the company had submitted a revised schedule of charges to the Board as a war measure. The industrial plants contended that they had contracts with the utility company covering a period later than the time noted (Feb. 1, 1918) which fixed the rates at a lower sum than that allowed by the board, and this, it was held, impaired the obligation of their contracts in violation of constitutional rights. In its decision the court said:

"Private contracts as to rates to be charged for furnishing electric power must yield to public welfare, and the state may fix a just and reasonable rate without regard to that reserved in the contract. Whether the Utility Commissioners are required to determine private rights, arising on contracts, in fixing rates for the public good, and to discriminate between those of the public who have contracts and those who have not, and otherwise make a discrimination according to agreements between citizens, or whether their orders should be general as to all who are within the class affected, we are not required to pass upon this case, although inclined to the opinion that such orders should be general, leaving the contracting parties to settle their rights in an action raising that question in which they are parties and not by certiorari. The record sustains the findings of the Board that the rates fixed are just and reasonable and we being of opinion that the order properly relates to the initial proceedings changing the rates, and that private contracts must give way to public welfare when they conflict, if that question can be raised in these proceedings, the writs in all the cases will be dismissed with costs."

Operating Practice

Window for Forced-Draft Chain-Grate Stokers—Automatic Substation Performance and Cost—Moving Long Pole Line

PROVISION FOR WATCHING FORCED-DRAFT CHAIN-GRATE STOKERS.

Window in Casing Enables Chain to Be Watched and Troubles to Be Avoided by the Breaking of Links.

When forced draft is applied to the chain-grate type of stoker, it is necessary to install wind plates underneath the grate to guide the air blast to the position where it is wanted, and to encase the stoker so that the air is forced through the fuel bed and not out into the boiler room or between the stoker grate and the bridge wall, etc.

There is, however, an objection to encasing or enclosing the chain-grate stoker in that the chain, or the grate bars, cannot then be seen. If a link or chain breaks, and these do break sometimes, it is necessary to replace the broken link otherwise the damage will spread and the chain will spread and finally fail altogether. The remedy is, of course, watchfulness on the part of the fire-room crew. When a link breaks, the rate of stoker travel can be reduced—the fire can be banked and the stoker stopped altogether, if necessary—until new links have been put in. This is a comparatively simple job, and is looked upon as merely an incident in a year's work.

With the stoker encased with sheet metal, which is invariably chosen, a link may break and the grate continue to be revolved without the fact being known, because the grate is invisible to the firemen. Under such conditions a broken link becomes a menace because of the extensive damage that may follow. The accompanying illustration shows the manner in which one company has overcome the objections to enclosing its chain-grate stokers, which was necessary when equipping their stokers with forced draft.

Windows in Stoker Casing as Used Successfully with Chain-Grate Stokers Using Forced Draft and High Rates of Combustion.

Two windows are provided in the casing of each stoker, these windows being of leaded glass. In the casing are installed two electric lamps, so arranged that they cast their light upon the grate. In this way the grate is visible at all times, and trouble due to broken links existing without knowledge is no more probable than when the grates are not encased.

The boilers shown are of 250 boiler hp., of which there are twelve in the station, and operate at ratings of 185% above normal. The use of the glass windows has reduced troubles due to breaking links which is, of course, more likely to occur with mechanical forced draft than with natural draft, because of the more rapid combustion rates and higher rate of travel of the grate and tendency toward higher fuel-bed temperatures.

AUTOMATIC RAILWAY SUBSTATION AT BUTTE PROVES ECONOMICAL.

Economy of Investment and Reliability in Service Cause Second Installation to Be Planned.

It was necessary for the Butte Electric Railway Co. to rearrange its railway distribution system because an existing power contract was lapsing and in order to reduce leakage current in the return because of electrolysis of underground pipes. This latter was eventually accomplished by adopting the insulated return-feeder system.

Were a railway substation located at the load center of the down-town of the company's system the cost was estimated to be $19,800 for copper plus $1700 expended for line loss in excess of that occurring if one substation were located in the down-town district and another in the South Butte residential district. As station operators receive $7 per day it would have been more economical to suffer the line loss than to install a manually operated substation on the basis of two 8-hour shifts for operators at $7 per diem, or $5110 per annum.

It was therefore decided to install an automatic substation, the decision being based upon the following estimates. The cost of the land, building, synchronous converter and control apparatus would be $9000, giving the fixed charges. One day's cleaning and inspection per week would cost $7 per day, or $364 annually. Materials and such incidentals as oil, brushes, contacts for the contactors, wiping cloths, etc., would cost about $256 per year. The total an-

nual charges for material and maintenance for the automatic substation would be $620 and the total actual cost $355.80. Of this latter amount, 82% would be for labor.

The automatic substation, consisting of one 500-kw., 60-cycle, 660-volt, six-phase, G. E., synchronous converter has now been in service for almost one and one-half years. During the first year the substation failed only on four occasions. On two of these occasions the auxiliary relay, the purpose of which is to keep the station from starting up when the alternating-current supply is below a definite voltage, failed to open, a condition since remedied by the adoption of a different type of relay. The second form of trouble responsible for another shutdown was that the thermostat protecting the machine from dangerous temperatures of the bearings functioning. The thermostat had been set at a needlessly low temperature and changing the setting has done away with this trouble. The third cause of shutdown was lightning, which entered the station before the lightning arresters had been installed, blowing a fuse and burning off a wire connecting up a lightning circuit with a 660-volt feeder.

Obviously, the above troubles are not serious and are merely incidental as contrasted with fundamental or inherent ones. In fact the automatic substation has proved so reliable that another station of similar type is expected to be installed at an early date. When this second unit is installed copper will be enabled to be recovered to the extent of $9000 and this proposed station would be available should either of the other two stations fail.

INTERESTING METHOD OF MOVING LARGE NUMBER OF POLES.

Use of Jacks Enables Pole Line to Be Moved Ten Feet to the Side Without Opening Circuits.

In building the King's Highway between Dover and Smyrna, Del., it was necessary for the telephone company to move 430 poles sideways a distance of 10 ft. Three methods of moving the pole line without interrupting the circuits in any way were tried.

The first method used consisted of digging a trench 10 ft. long and approximately 6 ft. deep. When several of these trenches were completed the poles were skidded to the new location, after which trenches were refilled and tamped. This method was not considered satisfactory, though, due to the high cost, which averaged about eighteen hours per pole, and introduction of a storm hazard due to disturbing the earth at the side of the poles, although with this method practically no circuit trouble was experienced.

Method No. 2 consisted of digging ten holes in the new location and removing poles 1, 3, 5, 7 and 9 and setting them in their new location. To do this it was necessary to remove the crossarms, after which they were placed on the poles in their new location, and then the wires were transferred. Next the crossarms were removed from poles 2, 4, 6, 8 and 10. Poles were taken down and set in their new locations, then crossarms were replaced and wires tied in. With the second method the hours of labor per pole were reduced from eighteen to twelve, as compared with the first. However, the trouble caused on the circuits with this method was excessive and, due to the importance of the circuits, it became obvious that some other plan of doing the work must be followed, as it was essential to keep the circuits in working order at all times.

The third and most successful method consisted of digging a number of holes in the new location and moving the poles by the use of simplex jacks. The following method was used in doing the job:

First operation—pole 1 guyed in direction away from which pole was to be moved.

Second operation—poles 1, 2, 3, 4 and 5 raised 1 ft. on simplex jacks.

Third operation—poles 1, 2, 3 and 4 raised 2 ft. on simplex jacks.

Fourth operation—poles 1, 2 and 3 raised 3 ft. on simplex jacks.

Fifth operation—poles 1 and 2 raised 4 ft. on simplex jacks.

Sixth operation—pole 1 raised to a sufficient height to allow a 2 by 12-in. by 10-ft. oak plank to be placed under butt of pole, after which pole was skidded on plank to new hole and lowered.

Seventh operation—the jack used at pole 1 transferred to pole 6. Pole 6 raised one foot.

Eighth operation—poles 2, 3, 4 and 5 raised 2 ft. on simplex jacks.

Ninth operation—poles 2, 3 and 4 raised 3 ft. on simplex jacks.

Tenth operation—poles 2 and 3 raised 4 ft. on simplex jacks.

Eleventh operation—pole 2 raised to a sufficient height to allow a 2 by 12-in. by 10-ft. oak plank to be placed under butt of pole, after which pole was skidded on plank and lowered.

The work of moving all poles continued in the order above and men followed with shovels and tampers, lining up the poles in their new locations.

With Method No. 3 it was found that the work could be done in approximately seven hours per pole and without causing any trouble on the circuits or damage to the wires, which was the objection to the second system.

By the improved process it was found perfectly feasible to raise the pole with the simplex jack completely out of the ground and then skid it to the hole at the new location. This dispenses with the intermittent or step-by-step process of raising the poles and resulted in a further reduction in the cost of moving the line.

The pole is first pulled out of the ground by means of the simplex jack, operated by two men while a third man holds the pole against the lean of the line with a rope guy on the road side. The pole is then launched on a plank or metal strip and skidded over to the new hole, using the simplex jack as a lever. This latter operation is usually in two stages, because the jack is not sufficiently long to permit the pole to be pushed ten feet in one operation. While the pole is being skidded to its new hole the man with the rope guy changes his position to the field side of the line so as to assist in pulling the pole over and lowering it into the hole.

The pole is lowered into the hole with no interruption of service and without any damaging effect to the open wire construction. The outfit of six men is divided into three-man gangs, each of which works at one pole; in this way two poles can be jacked over simultaneously. The gradual lean of the reset poles toward the pole that is being raised out of its old location takes care of all the slack required to permit the removal without untying the wires.

After about fifteen poles have been set in their new location the gang goes back to line up the poles and fills in the holes. The last poles of this newly lined up section are then supported with pikes or rope guys to prevent them from pulling out of line by the lean of the succeeding poles in process of being moved.

QUESTIONS AND ANSWERS

All readers are invited to submit questions and answers to this department. Anonymous communications will not be considered. Questions should relate to electrical matters of any kind. Answers contributed by readers should be submitted preferably within eight days of the date of publication of the question and should be limited, if possible, to 300 words. Payment will be made for all answers published.

Questions.

No. 467.—Operating Cost of Electric Household Refrigerators.—I would like to know from some reliable source what is the operating cost of the electrically operated refrigerators that are being recommended for household use. What is the experience as to their dependability?—R. H. T., New York, N. Y.

No. 475.—Pricing Motor Repair Work.—Can some of the readers through the questions and answers columns give me the best methods of pricing repair work on electric motors, armature winding, etc., and the best methods of setting the selling price of insulating materials and of magnet wire?—D. D., Indianapolis, Ind.

No. 476.—Colored Lighting Effects in Theater.—In producing the various changeable colored lighting effects in a theater that are now becoming so popular what is the smallest number of primary colors that will serve? Is it possible to get more pleasing gradations of color through using more sets of differently colored lamps than of primary colors alone? What is the most practical way to secure such color effects?—H. M. P., Seattle, Wash.

Answers.

No. 471.—Ringlemann Charts for Determining Smoke Density.—The use of Ringlemann charts is frequently mentioned in connection with the determination of the density of smoke emitted from smokestacks. I would much appreciate an explanation of what the Ringlemann chart actually is and how the density of smoke may be determined from its use.—M. A. P., Spokane, Wash.

(*Answer A* appeared in Oct. 11 issue.)

Answer B.—In order to make its enforcement easier and more certain a smoke ordinance must state definitely what density shall not be emitted. Some practical standard of comparison by which the density of the smoke may be determined should be specified. The Ringlemann smoke chart is one of these standards and consists of four cards having black lines forming squares upon them, the squares thus formed being of varying widths. Desirable widths and spacings as suggested by Professor Ringlemann are:

Card 1.—Black lines 1mm. thick 10mm. apart, leaving spaces 9mm. square.

Card 2.—Lines 2.3mm. thick, spaces 7.7mm. square.

Card 3.—Lines 3.7mm. thick, spaces 6.3mm. square.

Card 4.—Lines 5.5mm. thick, spaces 4.5mm. square.

Card 5.—All black—not always used.

Card 0.—All white—not always used.

In making observations of smoke proceeding from a chimney the four cards, printed in a horizontal row on one chart are hung at a point about 50 ft. from the observer and as nearly as convenient in line with the chimney. At this distance the individual lines become invisible, the cards ranging in tint from very light gray to black. The observer glances from the smoke coming from the chimney to the cards, determines which card most nearly corresponds with the color of the smoke, and makes a record accordingly, noting the card number and time of observation. The observations are repeated at one-fourth or one-half minute intervals. From these records the smoke density may be determined for each hour or fraction thereof for each day.—H. E. W., Chicago, Ill.

No. 473.—Changing Motor Frequency.—I would like information regarding changing of a ⅛-hp. Holtzer-Cabot single-phase motor of 1130 r. p. m. and 12 poles now operating on 133 cycles to make it possible to operate on 60 cycles at a speed of 1200 to 1300 r. p. m.—M. B., Dekalb, Ill.

To convert a ⅛-hp. motor designed for 133 cycles to use on 60 cycles at approximately 1200 r. p. m. it is necessary to rewind the motor, using a six-pole winding. To determine the proper winding, size wire and number of conductors per slot it is necessary to have detailed dimensions of the core and slots. It is also desirable to know the size of wire and number of conductors per slot used in the original winding.—H. S. R., Wahpeton, N. D.

No. 474.—Inferior Wire for Fixtures.—In my experience I have often run across fixtures wired with old Code wire and with No. 20 and even No. 22 low-voltage wire. I understand that considerable quantities of these wires are being used. What can be done by a contractor who wants to live up to rule 30*c* of the National Electrical Code to meet the competition of those who ignore this rule?—B. T. F., Morgan Park, Ill.

Any contractor that knows of a violation of the rules of the National Electrical Code, or of any city electrical code, should expose such violation publicly. This may be done in various ways. First he should assure himself that the parties perpetrating the violation are doing so intentionally and are not unaware of breaking the rules. With this fact established there is practically no limit as to how the exposure may be made. If there is municipal inspection, the inspection department should be informed. If insurance inspection alone prevails, the underwriters should be notified. If there is an organization of electrical contractors in the city, action should be brought through it to stop unfair competition. In the absence of any of these agencies the contractor who wants to see good construction carried out should expose the unscrupulous contractor to architects and builders directly and, if necessary, through newspaper advertisements or other means. This may stir up spirited disputes, but the honest contractor has all the merits of the dispute on his side. If he is well informed on the rules of good practice and can back them up with the reasons for their existence, he will readily get the public's support in his effort to safeguard the community against fire and accident hazards. If more contractors had the courage to take this stand poor construction would quickly become very rare.

The particular rule in question is one of the best rules of the National Electrical Code, although there are many electrical men who would like to see it made stiffer by making No. 16 B. & S. wire the smallest permissible size for fixtures instead of No. 18. I believe that where wire inferior to No. 18 approved wire is used it is by fixture men and contractors who, in the effort to save a few cents thereby, purchase the wire under various subterfuges. If the manufacturer could insist on knowing for what purpose the wire was to be used, he might refuse to sell low-voltage wire for fixtures. But some of these purchasers may ask for wire for automobile use and then wire fixtures with it. This makes the matter almost exclusively one for inspectors and competing contractors to work out.—S. D. C., Detroit, Mich.

Contractor-Dealer

Society for Electrical Development Prepares Holiday Helps for Dealers—Figuring Retail Prices—Merchandising Ideas

HOLIDAY HELPS PREPARED FOR THE ELECTRICAL DEALER.

Society for Electrical Development to Provide Extensive Co-operation for Entire Industry to Assist Holiday Selling.

There is a point in holiday selling that the retailer frequently overlooks. It is the fact that, in spite of natural increase in buying by the public at Christmas time, selling pressure should be kept up at that time and the retailer should add to his force and his stocks, if need be, to capitalize the holidays to the utmost. While the public is liberal in opening its purse for buying at Yuletide, it ties up the purse strings immediately after Christmas and there is usually a "valley" following the peak of holiday purchasing.

Window Trim Furnished as Dealer Help in "Electrical Christmas" Campaign.

The Society for Electrical Development has developed an extensive Christmas campaign for making the coming holidays most profitable for the retailer, and to help him provide against the post-holiday drop in buying by building up a good reserve.

The underlying motive of this campaign is to make this "an electrical Christmas," which idea is brought out forcibly in a beautiful poster design, lithographed in seven colors. This can be hung in windows, on doors and in the store. The same idea is dominant in the window-cards, poster-stamps and price-cards, all of which show the poster. Constant reiteration of this "theme" will have a favorable effect on the shoppers if the retailer uses the sales helps consistently.

Another notable fact about this campaign is that the society does not limit all the co-operative help to members exclusively but distributes certain things to non-members as well without charge. This material may be had by writing to the Society for Electrical Development, 29 West 39th street, New York City.

A CONVENIENT METHOD OF FIGURING RETAIL PRICES.

Simple Formula for Adding Profit and Overhead to Cost in Order to Obtain the Correct Price to Be Charged for Appliances.

In speaking before a recent convention of the Missouri State Association of Electrical Contractors and Dealers, M. S. Seelman, chairman of the committee on relations with contractors, dealers and jobbers, Commercial Section, National Electrical Light Association, made the following suggestions:

A simple method of arriving quickly at a fair price for which merchandise should be sold or work done to cover the cost, overhead and profit is to add the percentage of profit decided upon to the percentage of overhead, deduct the sum from 100, and divide the cost of merchandise or labor and material by the remainder. The result will be the selling price that must be obtained in order to cover the overhead and profit desired.

For instance, if the cost of some article of merchandise is $5, overhead is 25% and profit desired is 20%; deduct 45 from 100, leaving 55%; divide the

Poster Design to Be Used in "Electrical Christmas" Campaign.

cost, $5, by 0.55. The result, $9.09, is the price that must be obtained to cover the stated percentages of overhead and profit.

Profit may be considered as the net return after all expenses are added to cost. Therefore, if goods are to be carried for a certain length of time the percentage added is necessarily larger because of increased costs resulting from storage and fixed charges. On the other hand, if goods are sold soon after being purchased the profit percentage may be less. Seasonal articles carried in stock depreciate and must be sold promptly to insure a rapid turnover of capital.

Merchandising Suggestions for the Electrical Dealer

Fire Protection a Sales Point for Christmas-Tree Outfits—Dealer Service for Farmers — How Arcade Shop Sells Electric Cleaners

NOW is the time for the sale of lighting outfits for Christmas trees. The general public has come to learn and appreciate the convenience and beauty of electric lighting in comparison to the old-fashioned candles, and on the appeal of these advantages the electrical dealer is able to make a rapid turnover of such equipment.

But there is still another advantage the dealer can use. It is the fact that electric tree-lighting outfits are safer from fire hazard.

What better selling argument can one use than to tell a father or mother that electric lamps afford their little ones and their homes protection against the disastrous fires that are caused by Christmas-tree candles and the matches necessary to light them?

There isn't any question about the fact that there are many fires caused by candles, for the National Fire Protection Association recently issued a bulletin giving a warning against their use, and recommending that electric illumination is safer. Almost every one of us know of a case where a candle-lighted tree caused a serious fire. It is a point that strikes close to home and dealers ought to make use of it.

Convenience and beauty are excellent selling points, but when you add fire protection to them you have a trinity of arguments that simply must make room for sales.

Service for Farm Lighting Plants.

Introduction of farm electric plants in recent years has brought up an important question of service, says a prominent electrical dealer.

Service, according to his interpretation, means the expert attention to his electric plant which the owner may never need, but which he can have on short notice if he requires it.

The average farmer looks on an electric light and power plant as more than a piece of machinery. To him it is a means toward the end of furnishing complete and dependable isolated electric service.

The farmer is not an electrician and doesn't want to be one. He knows machinery and knows how to take care of it, but he also knows that the best machinery in the world sometimes needs expert attention. He wants to know that there's an experienced mechanic within reach to give his electric plant attention when necessary.

Two main things are to be considered in the purchase of a farm electric plant; first, other users' experiences. With the great increase in the use of electricity on the farm in the last few years there is scarcely a community where electric plants are not in use. It is easy for the prospective buyer to inquire among his neighbors as to the satisfaction they are receiving from their plants.

The second and equally important factor to consider is the local representation of the particular plant he plans to buy. An established representative of the plant in the community assures service when needed.

The average farmer is a careful buyer, and will doubtless take these things into consideration. If he does he is more likely to be assured of continuous and dependable electric service in his home.

Arcade Shop Features Vacuum Cleaners.

Cleveland—noted for its arcades as well as for being the "sixth city"—has quite a number of arcade electric shops. One of the advantages of an arcade is that it affords window space. Shops are not so deep as those with street frontage, and for a corresponding amount of floor space considerably more window space is secured. This permits of a larger exhibition of goods, so passersby may do more "window shopping" of things electrical.

View of Part of Electric Shop in Cleveland Arcade.

One of these arcade electric shops—the Electrical Necessities Co.—recently had a display in which was arranged tables devoted to a single household necessity—electric irons, percolators, vibrators, toasters, grills—while one table was set for breakfast, holding all the electric implements for preparing same. At one side of the room were the kitchen and laundry conveniences, and at the other an array of electric lamps with silk, parchment and art glass shades.

The firm makes a specialty of vacuum cleaners, and, according to Mr. Burgess, the manager, business the past season has been exceptionally good. Patrons are circularized regularly, and whenever a special display is made announcements are sent to customers and advertisements as well as making statements in the daily papers. A recent vacuum cleaner display attracted the attention of all who passed through the arcade. In the center was a small, ancient looking vacuum cleaner, with a card which informed the public was "Grandpa Hoover—the first suction sweeper made—sold for $125 cash." Nearby was one of the 1919 models, selling for $57.50. A card beside it observed: "Over 40,000 Hoover grandchildren have been sold in Cleveland."

New Appliances

Powerful Electric Locomotive for Mountain Division—Automatic Light Plant—Automatic Projector—Carpet Washer

New Direct-Current Gearless Passenger Locomotives for C., M. & St. P. Railway.

The new 3000-volt direct-current locomotives here described are now being placed in operation for the passenger service on the Othello-Seattle-Tacoma electric zone of the Chicago, Milwaukee & St. Paul Railway.

A large group of railroad officials, mechanical and electrical engineers inspected this new type of passenger locomotive at the General Electric works at Erie, Pa., on Nov. 7. After detailed inspections, the locomotives were subjected to numerous running and control tests.

The original electrification from Harlowton to Avery, 440 miles, has now been operating for a number of years under the extremely bad weather conditions of the Rockies and Bitter Root mountains and, as a result of its unqualified success, the same system will now be used to meet the severe grades and snow conditions of the Cascade range. All the equipment for the original electrification was manufactured by the General Electric Co. including substations and locomotives. The motive power consisted of 42 locomotives for freight and passenger service and four switchers. Of this original equipment, the freight and passenger locomotives were practically the same and differed from each other only in the gear ratio between motors and driving axles.

The new locomotives are an entirely different design, built distinctively for passenger service and possess some very interesting mechanical and electrical features. They will be used on the new Cascade electrification strictly for passenger service and the present passenger engines will be adapted for freight service by changing their gear ratio. The new locomotives are of the bipolar gearless type, with motor armatures mounted directly on the driving axles. In this fundamental feature, they follow the design of the gearless locomotives in use on the New York terminal of the New York Central Railroad, which have given remarkable operating results during the past ten years. The chief advantage of this method of construction is the great simplicity of mechanical design which eliminates all gears, armature and suspension bearings, jackshafts, siderods or other transmitting devices. The remarkably low cost of maintenance of the New York Central locomotives over the entire period is attributed largely to the gearless type of construction.

Each of the new C., M. & St. P. passenger locomotives weighs 265 tons with 229 tons on drivers. They have 14 axles, 12 of which are driving and two guiding axles. The weight of the armature and wheels is the only dead weight on the track and this is approximately 9500 lbs. per axle. The total weight on drivers (458,000 lbs.) is 86% of the weight of the locomotive but, being distributed among 12 axles, results in a weight of only 38,166 lbs. per axle.

One of the most interesting and important features of the locomotive is the design of the leading and trailing trucks and the method of suspension of the cab weight upon them. The successive trucks are coupled together in such a way as to deadbeat or break up any lateral oscillations which may be caused by inequalities of the track. The weight of the main cab is so supported on the front and rear trucks that any lateral thrust or kick of the leading or trailing wheel against the track is cushioned by the movement of the main cab, which increases the weight bearing down on the wheels at the point where the thrust occurs, and automatically reacts to prevent any distortion of the track. The result of this design is such as to give riding qualities at high speeds which have probably never been attained before in a double-ended locomotive. Exhaustive tests on the General Electric test tracks at Erie, Pa., have demonstrated the remarkable riding qualities of the new locomotive at speeds as high as 65 m. p. h., which is the limit of speed on the length of test track available. These tests also indicate that the locomotive will operate at much higher speeds with equal success.

The locomotive is designed for handling in normal service a 12-car train weighing 960 tons trailing against a grade of 2% at 25 m. p. h. This performance requires 56,500 lbs. tractive effort which is equivalent to a coefficient of adhesion of 12.3% of the weight upon the driving axles. The wide margin thus provided between the operating tractive coefficient and the slipping point of the wheels, as well as the ample capacity of the motors, will allow this locomotive to haul trains with as many as 14 cars in emergencies. For continuous operation, the locomotive is designed to operate at 42,000 lbs. tractive effort at a speed of 25 m. p. h.

The total weight supported on driving axles is practically the same as that on the present geared passenger locomotives, weighing a total of 300 tons. The table below gives the principal dimensions, weights and capacity of the gearless locomotive.

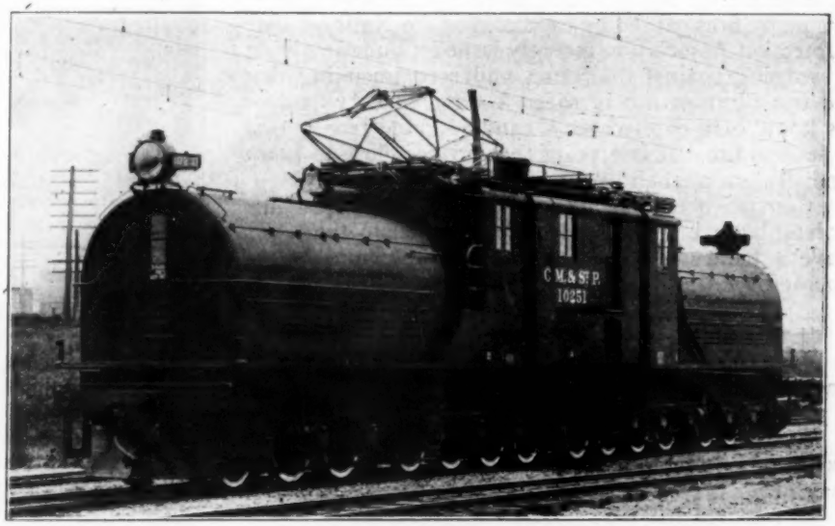


Fig. 1.—3000-Volt, Direct-Current, Gearless Passenger Locomotive for C., M. & St. P. Cascade Electrified Zone.

Length inside knuckles	76 ft. 0 in.
Length over cab	68 ft. 0 in.
Total wheel base	67 ft. 0 in.
Rigid wheel base	13 ft. 11 in.
Diameter driving wheels	44 in.
Diameter guiding wheels	36 in.
Weight electrical equipment	235,000 lbs.
Weight mechanical equipment	295,000 lbs.
Weight complete locomotive	530,000 lbs.
Weight on drivers	458,000 lbs.
Weight on guiding axle	36,000 lbs.
Weight on each driving axle	38,166 lbs.
Number of motors	12
One-hour rating	3240 hp.
Continuous rating	2760 hp.
Tractive effort—1-hour rating	46,000 lbs.
Tractive effort — continuous rating	42,000 lbs.
Tractive effort — 2% ruling grade with 960-ton train	56,500 lbs.
Coefficient of adhesion ruling grade	12.3%
Starting tractive effort—25% coefficient of adhesion	115,000 lbs.
Rate of acceleration starting 2% ruling grade	0.48 m.p.h.p.s.

Control equipment for the new locomotive is similar in most respects to that used on the original locomotives

which have now been operating nearly four years. Modifications were, of course, necessary to comply with the different arrangements of motors. Advantage is taken of a new scheme of connections by means of which four of the main locomotive motors are utilized to furnish exciting current during regeneration, thus reducing the size of the motor-generator set used for control, accessories and train lighting. An appreciable reduction in the weight of control equipment is obtained, at the same time providing for effective regenerative electric braking on the down grades. The motor-generator set furnishes control current for operating the contactors and for charging an 80-volt storage battery which supplies lights and power for the accessory apparatus. This battery is, in general, similar to those used on the passenger coaches. The master controller is constructed in three sections arranged for both motoring and regenerating, all of the cylinders being suitably interlocked to prevent incorrect manipulation.

Each of the 12 driving motors is bipolar, two fields being supported upon the truck springs with full freedom for vertical play of the armature between the pole faces. Fig. 2 shows the end outline of the locomotive with a sectional view of one of the motors indicating the location of the armatures and the magnetic section. For full-speed operation, the 12 motors are connected three in series with 1000 volts per commutator. Control connections are also provided for operating 4, 6 or 12 motors in series. Additional speed variation is obtained by tapping the motor fields in all combinations. Cooling air for each pair of motors is supplied by a small motor-driven blower. This arrangement avoids

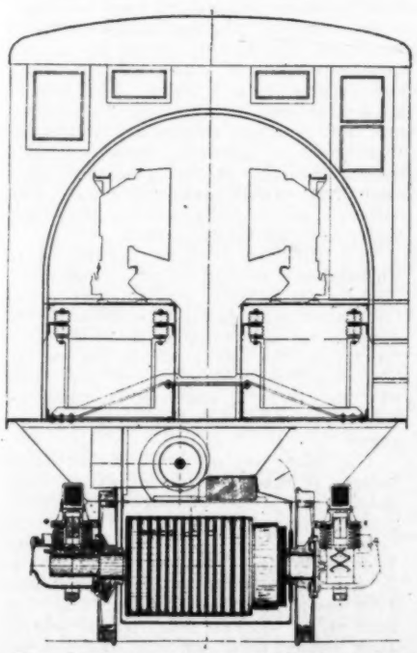


Fig. 2.—End Outline and Motor Cross Section of New Gearless Locomotive.

the heavy duct losses encountered with a single large blower.

As may be seen from the curves of Fig. 3, the gearless locomotive shows a much better efficiency at high speeds than the geared type, owing to the elimination of the gear drive. In passenger service, where there are long stretches of level track and stopping points are comparatively few, a much higher efficiency is obtained in all-day service. These curves show an efficiency at 50 m. p. h. approximately 10% higher than the geared type of locomotive.

The 3000-volt contactors and grid resistors are mounted in the curved end

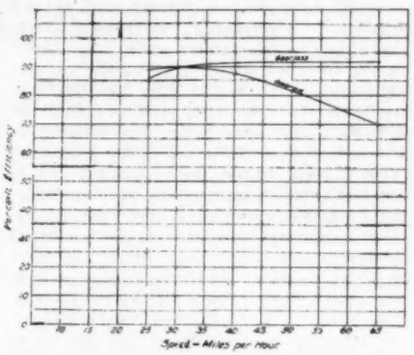


Fig. 3.—Comparative Efficiency Curves of Geared and Gearless Locomotives.

cab at each end of the locomotive. In one of these cabs there is also located the 3000-volt air compressor and storage battery. In the other is located a small motor-generator set and the high-speed circuit-breaker. The operating cabs contain the master controller, indicating instruments, and a small air compressor (in No. 2 cab) operated from the battery circuit with sufficient capacity for raising the pantograph when first putting the locomotive in operation. Near the controller are the usual air-brake handles for standard braking equipment.

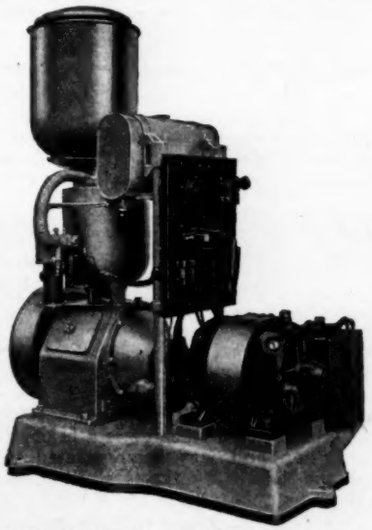
In the center cab is the oil-fired steam boiler for heating passenger trains with accessories including tanks for oil and water, circulating pumps and a motor-driven blower for furnishing forced draft. A slider pantograph, similar in construction to those now in use, is mounted on each of the operating cabs. This pantograph has two sliding contacts, giving a total of four points per slider with the double trolley. The pantograph and flexible twin trolley construction enable the locomotives to collect currents as high as 2000 amperes at speeds up to to 60 m. p. h. without noticeable arcing at the contact points. The second pantograph is held in reserve as a spare. Sand boxes, with pipes leading to each pair of driving wheels, are located directly beneath the pantograph and outside of the operating cab.

The new locomotives will operate over the section between Othello, Seattle and Tacoma, including 17 miles of 2.2% grade from the Columbia river west and 19 miles of 1.7% grade between Cedar Falls and the summit of the Cascades. The traffic over this division consists of the heavy main line transcontinental passenger trains "Olympian" and "Columbian," carrying from 8 to 12 steel passenger coaches which will be handled over the maximum grades without helpers. Freight pushers are already in operation on the 2.2% grade using two of the locomotives from the original electrification. It is expected that electrical operation during the coming winter will assist in overcoming many of the delays which are commonly met with during almost every winter's operation in this district in Washington.

Holt 110-Volt Automatic Electric Light and Power Plant for Rural Service.

Among farmers and other rural residents who cannot secure electric service from central-station lines there is an increasing call for a simple, self-contained electric light and power plant of standard voltage. Such a plant permits of a standard wiring installation, use of standard-voltage lamps and appliances, eliminates need for a large storage battery, and enables a change-over to be made readily at any later time to central-station service when power lines are brought near to the farm or ranch. A plant to meet this need has been developed by the Automatic Light Co., Inc., Ludington, Mich. It is known as the Holt 110-volt automatic power-light plant.

This plan thas been developed during several years and incorporates the results of much experience in this line. It consists of a four-cycle, water-cooled gasoline engine with a six-volt ignition and starting storage battery of 86 ampere-hour capacity. The engine is direct-connected to a General Electric 750-watt compound geenrator with double armature winding and double commutator, one for 6 volts and the other for 110 volts. The 6-volt winding feeds the ignition and starting battery; the 110-volt winding the load. On closing a switch on any of the load circuits the battery is thrown on the low-voltage winding which acts as motor and starts the engine just like any standard automobile self-starter. The control is simple and compact. Constant voltage is



Holt Automatic 110-Volt Power and Light Plant.

secured through the compound winding regardless of the amount of load up to the capacity of the set.

The Owen Automatic Stereopticon.

The Owen automatic stereopticon illustrated herewith demonstrates a new use of electricity and is a simple device that can be carried in a suitcase. It is claimed that it costs little to operate, it

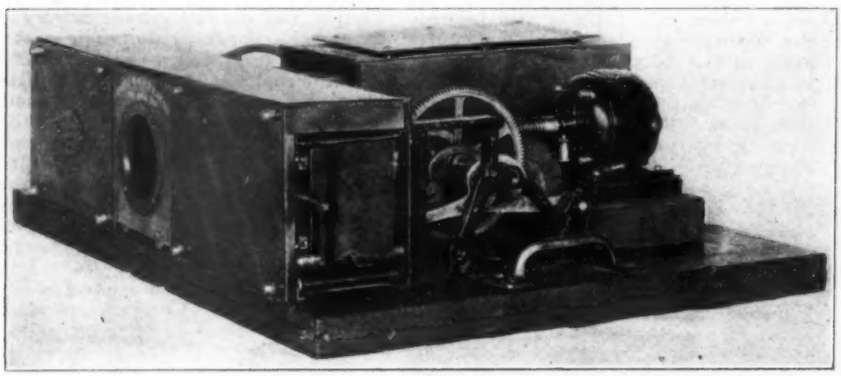
has nothing to wear out or replace, and will last practically a lifetime.

Its essential parts are a 1000-cp., gas-filled Mazda projection lamp, condensing and objective lenses, a screen upon which the pictures are to be projected, the necessary slides, and a small General Electric motor to be attached to an electric light socket and which operates on either direct or alternating current.

The usual size projects 46 slides upon the screen, allowing each to remain in position twelve seconds, when it is automatically replaced by the next. Machines which project 100, 200 or more slides may be built to order.

The picture may be shown either large or small by merely varying the distance of the objective lens from the screen. The projection is in the form of a cone with the small end at the lens, and the large end on the screen, and the farther the screen from the machine, the larger the picture.

This automatic stereopticon is invaluable for store and window advertising, for educational work, home entertainments, and for a variety of purposes that will suggest themselves. Attractive and interesting, tireless and reliable, it is one of the best sellers of all commodities.



Easily Portable Stereopticon for Automatically Exhibiting Advertising or Educational Slides.

Electrically Operated Carpet Washer for Hotels, Clubs and Similar Institutions.

One of the displays at the recent Chicago Electrical Show that attracted special attention from the thousands who daily visited the Coliseum was the electrical carpet washer, shown for the first time. The machine is a brand new invention and was demonstrated daily in the booth of the Hamilton-Beach Manufacturing Co., of Racine, Wis. This machine scrubs and cleanses rugs of any size right on the floor.

For demonstration purposes, an offer was made to all attending the show to clean without cost all rugs brought in. Hundreds of rugs, ranging all the way from priceless orientals to humble domestics, were cleaned daily. The hundreds who wedged themselves about the exhibit were astonished to behold rugs, which had been given hard wear and become so dirty that scarcely any pattern or design could be distinguished in them, emerge from the washing process looking as bright as on the day they were purchased.

The washer is extremely simple in construction and does not require experienced help to operate it. Soap suds are made from pure water and a special soap compound. This compound is said to be free from all chemicals and animal fats, its base being a vegetable oil that leaves the carpet sweet-smelling and sanitary. The suds are poured into an aluminum container and are fed through a small tube into a heater and mixer which is electrically warmed. From there, the rich, creamy suds flow down to the brushes which rest lightly on the surface of the rug. The brushes are made of the same soft porous rubber as a bath sponge and when the washer is in operation oscillate 500 times a minute. The movement of the human hand is thus exactly duplicated by the machine, only hundreds of times more effectively. The cleaning compound is scrubbed down to the very bottom of the nap, cleaning every fiber of the rug or carpet and bringing back all the colors that delighted the eye when the rug was new. A vacuum suction draws all the dirty suds back into a separate container and when the cleansing of the rugs is completed this dirty water is thrown away.

Rug experts who have watched the machine in operation state that it is harmless to the finest rugs and they have no hesitancy in endorsing it in the highest terms. Reports received from hotels, clubs and other institutions which have tried the machine indicate that it cleans the rugs in a very satisfactory manner and at a minimum cost.

The saving effected in cleaning rugs without removing them from the floor will quickly offset the cost of the machine. The additional advantage offered is that it does not become necessary to leave bare and unsightly floors while rugs and carpets are being cleaned. The work is done very quickly and at a very low cost.

Ship Cleaning by Electricity.

An important invention has recently been made in connection with the cleaning of ships' hulls while afloat. The present method is to dry-dock the vessels periodically and set a small army of workers out to chip away the marine growths which have accumulated during a voyage. The expense involved is heavy. For the dry-docking of a 7000-ton ship a charge of about $750 a day is incurred, exclusive of the cost of cleaning, which is a big additional item. With the new apparatus described below it is claimed that this operation can be performed in eight hours by a party of four men, and without any necessity of dry-docking. The new patent is known as the torpedo submarine ship cleaner, and the Rapid Submersible Ship Cleaner Co., London, Eng., has acquired the existing patent rights in connection with it. The apparatus consists of a frame containing a revolving cylindrical brush worked by a submersible motor. At the back of the frame is a screw propeller which forces the brush firmly against the side of the vessel. The power is supplied by a generating set on board a barge carrying a jib from which the machine is suspended, and the only connection between the barge and the ship being cleaned is the fore and aft mooring ropes used for maneuvering purposes. In operation the machine is lowered overboard from the jib, the motor is started, and the screw at once forces the brush against the side of the vessel, and while rotating is lowered down to the required depth, cleaning as it is moved up and down.

New Storage-Battery Jar That Has Proved Practically Unbreakable.

The storage battery in the mind of the average layman is apt to mean a "black box of mystery" mounted on his automobile to start his motor and furnish current for his lights. He is very apt to regard the battery as being delicate in construction, whereas the storage battery actually is today playing a very important part in the most strenuous service. As an instance of this the mine locomotive may be cited.

This mine service is usually very severe and the battery must be exceptionally rugged to withstand the bangs and bumps they receive. The tracks as a rule are bad and head-collisions are not unusual. The battery has in this service, however, made a wonderful record. In the past there has been but one serious objection—the battery jars would sometimes crack under an unusually severe jolt.

The Electric Storage Battery Co., Philadelphia, manufacturer of the Ironclad-Exide battery, realizing this, has for some time been experimenting to develop an unbreakable jar. What is known as the Giant jar is the result. This was briefly described in our issue of Nov. 1, 1919, since which time the following additional data have been secured.

The Giant jar of the Ironclad-Exide battery is made of a semiflexible compound, exceptionally tough and strong. Exhaustive tests have proved that these Giant jars will stand a pressure of 2000 lbs. at their weakest point, whereas the old type jar broke at less than 1000 lbs.; that the Giant jar will support at its weakest point the weight of four husky men, whereas the old jar would not support the weight of one man; that an electrical test of 30,000 volts does not puncture the Giant jar.

Moreover, thousands of these jars have in actual service demonstrated their ability to withstand the hardest and most severe service. This jar is now the standard for the Ironclad-Exide battery that is so very extensively used for mine locomotives, industrial trucks and tractors.

Trade Activities

Mack Searchlight Truck Exhibit—Sterling Manufacturing Erecting New Plant—Special Literature Distributed

Belden Manufacturing Co., Chicago, is sending out Bulletin 1214 on winding machines and coil winding apparatus. This bulletin, which is issued in advance of the new catalog No. 8, introduces a number of new machines which have been developed for use by the trade. These machines are described in detail with illustrations accompanying the text.

Attachment Plug Patent Litigation.—In the suit of Harvey Hubbell, Inc., vs. the General Electric Co. and Bryant Electric Co., for infringement of Hubbell patent Nos. 774,250 and 774,251 covering attachment plugs, decisions have been filed by Judge Thomas in the United States District Court upholding the Hubbell patents and finding infringement thereof. In the suit of Bryant Electric Co. vs. Harvey Hubbell, Inc., charging infringement of the Burton patent, a decision has been filed by Judge Thomas in the United States District Court, finding the Burton patent invalid.

Sterling Manufacturing Co., Cleveland, Ohio, manufacturer of ammeters and voltmeters, is constructing a new plant, which it is expected will be ready for occupancy within three weeks. The building, which is of reinforced concrete construction, is two stories, 65x100 ft. Provision has been made for the erection of another story should this be found necessary. In addition to this structure, the company is now planning to erect an office building, 60x75 ft. and expects to start construction work very shortly.

Benjamin Electric Manufacturing Co, Chicago, is sending out a new and very complete catalog of 96 pages descriptive of Benjamin illuminating and wire devices and specialties. Several pages are devoted to illustrated descriptions of new Benjamin material, comprising elliptical angle and other reflectors, reflector socket with wire-glass guard, shade-holder reflectors, moisture and dustproof fixtures, safety flash receptacles, clusters for stand lamps, etc., which are bound in the front of the catalog. For the convenience of the user, the standard line of Benjamin products is grouped in schedules as follows: wireless clusters and plug clusters, reflectors and lighting fixtures, special Mazda C fixtures, wiring devices and specialties, accessories, tool sets and automobile devices. In addition to the detailed and illustrated descriptions of these products, the catalog contains considerable valuable data on illumination. A convenient feature of this publication is the numerical index, which gives full details covering standard package quantities, weights and discount schedules.

Hugh L. Cooper & Co., 101 Park avenue, New York City, has issued a neat book of views of water power projects entitled "Hydro-Electric Developments." The projects illustrated are some of those in the construction of which the company has been engaged and include the Mississippi development at Keokuk, Iowa, the Electrical Development Co.'s plant at Niagara Falls, N. Y., the McCall Ferry development at Holtwood, Pa., the Sao Paulo dam in Brazil, and the Winnipeg Electric Railway development at Lac du Bonnet, Canada. The views indicate some of the difficulties that the water power engineer has to contend with in some instances.

Ingersoll-Rand Co., 11 Broadway, New York City, has issued a number of new pieces of literature on its various products. Form 8707 is a 40-page bulletin on "Little David" pneumatic drills, grinders and saws. Various sizes and models of the different machines are illustrated and detailed descriptions concerning the particular tool to use for a given purpose are included. The descriptive matter is supplemented with a number of tables giving air consumption of the various tools, etc. Another publication is entitled "'Tis a Good Investment," illustrating and briefly describing Class ER and Class FR compressors in small machine shops, power houses, garages, etc. A third bulletin describes the air lift method of pumping and shows a view of the installation of the Ingersoll-Rand air lift in a Georgia water works. The company will soon have ready for distribution Form 9029 which will be a pictorial products catalog, illustrating and describing practically the entire line of products marketed by this concern. Copies of these bulletins will be sent free on request to either the New York office or any of the branch offices.

Mack Searchlight Truck Exhibited in New York.—One of the interesting exhibits made during the Motor Transport Corps' show in New York on Oct. 16-18, was the Mack 5-ton searchlight truck illustrated herewith. This truck was made by the International Motor Co., New York City, and formed one of a fleet of trucks used by army engineers for night work in building roads, bridges and similar works. The engine on the truck is arranged to drive the truck and also to drive a 15-kw. generator, for furnishing energy to the 1,000,000-cp., 40-in. field searchlight. The latter is mounted on a separate chassis and can be easily removed from the truck and placed in any position desired.

The Motor Transport Corps controls all army motor equipment except heavy artillery tractors, tanks and hospital ambulances. When we entered the war, the United States Army did not own more than a thousand motor trucks. A year and a half later it had 124,800 trucks and passenger cars and 21,780 motorcycles in France, and 33,700 trucks and passenger cars, and 10,170 motorcycles in this country. Of this total of 190,450 motor vehicles, all but 7800 were American made.

Mack 5-ton Searchlight Truck with Portable 40-in. Searchlight Displayed at Motor Transport Corps Exhibition.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

Rutland, Vt.—Rutland Railway, Light & Power Co. has recently completed the installation of a new generating unit in its Mendon station, and it is expected that service will be inaugurated at once.

Springfield, Vt.—Colonial Power & Light Co. has been awarded a contract for furnishing additional service for the proposed addition to the Orchard Park Hotel, Manchester, Vt., as well as to the new addition to be erected by the Equinox Co., operating the Equinox Hotel.

Boston, Mass.—Charles H. Tenny & Co., 201 Devonshire street, operating gas and electric light plants in the vicinity of Boston and throughout New England, have completed arrangements for the purchase of the Worcester Gas Light Co., Worcester. It is understood that the new owners will continue the operation of the plant.

Lowell, Mass.—A number of the large textile plants in this vicinity are arranging for the use of fuel oil at their power plants, and oil burning equipment, including burners, pumps, tanks, etc., will be installed. These mills include the Merrima Manufacturing Co. and the Tremont & Suffolk Mills. The American Woolen Co. is now using oil fuel almost exclusively at its mills at Lawrence, Mass.

Meriden, Conn.—Cuno Engineering Co. is having plans prepared for a two-story steel and reinforced concrete plant, 190x230 ft., on a site recently acquired on Colony street. Max J. Unkelbach, New Britain, is architect.

Brooklyn, N. Y.—Brooklyn City Railroad Co. has completed negotiations for the disposal of its property on Flushing avenue and Hopkins street, between Nostrand and Marcy avenues, formerly used for power station and other service, to new interests.

Middleport, N. Y.—Niagara Spray Co. is having preliminary plans prepared for the construction of a number of local manufacturing buildings, including a large machine shop, chemical buildings, with power plant for general works operations, and auxiliary structures. The buildings will be of brick and reinforced concrete construction.

Rochester, N. Y.—American Laundry Machinery Co. has awarded a contract to John Luthere & Sons, 176 North street, for the erection of a new one-story machine shop addition to its plant, located in the Lincoln Park district, about 160x200 ft. Considerable electrical equipment will be required. The structure is estimated to cost $50,000.

Schenectady, N. Y.—General Electric Co. has filed plans for the erection of a new one-story brass foundry addition to its local plant, to be erected at Building No. 89. The structure will be about 100x100 ft., and is estimated to cost $30,000. Contract for construction has been awarded to the H. K. Ferguson Co., Cleveland, Ohio.

Dover, N. J.—New Jersey Power & Light Co. has arranged plans for the construction of a 33,000-volt transmission line to the Replogle mine of the Wharton Steel Co., for furnishing additional electric service for the operation of the properties, at which location a quantity of new machinery is now being installed. The plans include the erection of a new 33,000-volt substation at the mine. The company has also been awarded a contract for furnishing electric power for the operation of the proposed plant of Paul Guenther & Co., Inc., to be located at Wharton.

Harrison, N. J.—Crucible Steel Co. of America, Middlesex street, has completed plans for the construction of a new one-story brick and steel boiler plant addition to its works, to be located on South Fourth street.

Jersey City, N. J.—Pennsylvania Railroad Co. has filed plans for the erection of a new brick cable building at Railroad avenue and Warren street.

Newark, N. J.—Splitdorf Electrical Co., 98 Warren street, has had plans prepared for alterations and improvements in its plant. It is proposed to commence the work at once.

Newark, N. J.—In connection with the construction of the proposed group of hospital buildings at the County Hospital, Overbrook, contracts for which were recently awarded, considerable new electrical and mechanical equipment will be required. The work will include the erection of five structures, and contracts for all miscellaneous work, including heating, plumbing, etc., have been awarded to insure the early completion of the work.

Philadelphia, Pa. — Philadelphia Storage Battery Co., Ontario and C streets, has completed negotiations for the purchase of property at the southwest corner of Ontario and C streets, about 120x195 ft., for a consideration of approximately $13,500.

Philadelphia, Pa.—Plans and specifications for the proposed improvements in the filtration plant at the municipal waterworks plant, Queen Lane station, have been approved by the State Commissioner of Health, and it is proposed to call for bids immediately. The new improvement will approximately double the present capacity of the plant, and is estimated to cost $500,000. Considerable electrical equipment will be required in connection with the work.

Philadelphia, Pa.—Board of managers of the Chester Hospital, Chester, has had revised plans prepared for the construction of a new boiler plant at the institution, as well as other improvements and alterations, including the installation of new heating equipment, plumbing, etc. Ballinger & Perrot, 17th and Arch streets, Philadelphia, are architects.

Pittsburgh, Pa.—Negotiations have been completed by the J. A. Williams Co. for the leasing of the three-story brick building at Shadyside station on the Pennsylvania railroad, about 212x222 ft., on property 212x275 ft., formerly used by the Westinghouse Electric & Manufacturing Co. for the manufacture of shells. The structure comprises approximately 170,000 sq. ft. of floor space.

Reading, Pa.—Metropolitan Edison Co. is arranging for extensive improvements and extensions in its plants and system, including the completion of work on the construction of new high-tension lines. The company, which operates in West Reading, Reading, Lebanon, and Norristown, as well as neighboring sections, has recently authorized an increase in its capital stock from $5,000,000 to $8,000,000, a portion of the proceeds to be used for the proposed expansion.

York, Pa.—Otto Eisenlohr & Brother, Ninth and Market streets, Philadelphia, have completed plans for the erection of a new boiler plant, one-story, to be constructed in connection with other additions at their local plant. The entire work is estimated to cost $50,000. John Hamme, 31 West Market street, York, is architect.

Baltimore, Md.—Park commissioners have approved an appropriation of $18,000, of which $12,000 will be utilized for the lighting of the Mill Race Drive; $3000 for improvements in the lighting system in Carroll Park; and $3000 for improvements in the electric lighting system in Druid Hill Park.

Riverton, Va.—Shenandoah Valley Milling Co. will install a 1600-hp. hydroelectric plant on Shenandoah river and will let contract for electrical equipment. Address Alfred M. Quick, consulting engineer, 418 Equitable building, Baltimore, Md.

Stanley, Va.—Pool Brothers are having plans prepared for the construction of a new electric transmission system and plant.

NORTH CENTRAL STATES.

Cincinnati, Ohio—As a means of protecting the city against possible

shortage of electric power, W. W. Freeman, president of the Union Gas & Electric Co., asked the Rapid Transit Commission to let the water into the canal again between the present dam and Charles street. Mr. Freeman proposes to build a dam at Charles street and to use the water power until such a time as the city is ready to proceed with its work on the new rapid transit system.

Dover, Ohio—The $100,000 bond issue for extension to the city light plant and waterworks probably will be submitted to a referendum vote.

Lebanon, Ohio—The city has under consideration the erection of a municipal electric power plant.

Marion, Ohio—An ordinance was passed by the council authorizing the Columbus, Delaware & Marion Railway Co. to install a large number of street lights in this city. Address city auditor.

Columbus, Ind.—S. J. Peabody Lumber Co. will double the capacity of its hardwood mill. The machinery will be operated by electricity.

Portland, Ind.—The city will expend $100,000 building a municipal electric light and power plant, the public service commission having given authority to issue bonds.

Carlinville, Ill.—Standard Oil Co. is making plans to bring the electric power from the big Schoper power to the Berry mine. When this is done the electrical machinery will be installed and the steam engines will be taken out. The power will also be brought to Mine No. 1-A and the steam plant taken out as soon as the work is completed to the Berry mine. The wires will be brought underground from Barry to Mine No. 1-A.

Chicago, Ill.—Chicago Electric Manufacturing Co., 2811 South Halsted street, will build a two-story plant, 100x133 ft., to cost $60,000. George Knouff, president.

Chicago, Ill.—Century Rubber Works have plans for erection of a large plant, to cost $300,000, to be ready for occupancy June 1, 1920.

Chicago, Ill.—Crane Medicine Co. will erect an eight-story concrete factory building, 99x130 ft., at an investment of $300,000.

Chicago, Ill.—Architect E. H. Frohman, 64 West Randolph street, has prepared plans for a $125,000 electric specialty factory to be erected by Birdman Electric Co. Brick and stone construction. Specifications include freight elevator, steam heating, plumbing and electric lighting. A. Appel, 1422 West Randolph street, is president of the company.

Chicago, Ill.—Kirk D. Holland will erect a three-story factory building, 25x130 ft., for the Double Seal Piston Ring Co., to cost $80,000.

Chicago, Ill.—Plamondon Co., manufacturer of transmission machinery, has purchased property on which it proposes to erect a plant to cost $1,000,000. Work has started on a 200x500 ft., one-story concrete building, to cost about $250,000, which will be the first unit of the plant; and will have approximately 100,000 sq. ft. of floor space.

DATES AHEAD.

Electrical Supply Jobbers' Association. Semi-annual meeting, Cleveland, Ohio, Nov. 18-20. Headquarters, Hotel Cleveland. Secretary, Franklin Overbagh, 400 South Clinton street, Chicago.

American Society of Mechanical Engineers. Annual meeting, New York City, Dec. 2-5. Secretary, Calvin W. Rice, 29 West 39th street, New York City.

American Institute of Chemical Engineers. Annual meeting, Savannah, Ga., Dec. 3-6. Secretary, J. C. Olsen, Brooklyn, N. Y.

Electric Power Club. Meeting, Hot Springs, Va., Dec. 11, 12 and 13. Headquarters, Homestead Hotel. Secretary, C. H. Roth, 1410 West Adams street, Chicago.

National Council of Lighting Fixture Manufacturers. Annual convention, Detroit, Mich., February, 1920. Secretary-treasurer, Charles H. Hofrichter, Cleveland, Ohio.

American Electrochemical Society. Annual convention, Boston, Mass., April 7-10, 1920. Friday, April 9, joint session with American Institute of Electrical Engineers on "Electrically Produced Alloys." Secretary, Joseph W. Richards, Bethlehem, Pa.

National Electric Light Association. Annual convention, Pasadena, Cal., May 18-21, 1920. Headquarters, Hotel Huntington. Acting secretary, S. A. Sewall, 29 West 39th street, New York City.

Chicago, Ill.—Wilson-Jones Loose Leaf Co. will erect a two-story building, 260x360 ft. at Franklin boulevard and Spaulding avenue and will cost $750,000. The new building will have a total floor space of 187,000 sq. ft.

Chicago, Ill.—Property has been purchased by the Union Wire Mattress Co. on which it is proposed to erect a plant to cost $500,000, with a floor area of about 200,000 sq. ft. The first unit of the plant will be started in spring.

Chicago, Ill.—Arthur Jones Electrical Co., 2837 South State street, is planning to build a two-story plant, 125x125 ft., to cost $60,000.

East St. Louis, Ill.—Home Ice Cream Co. will erect plant, 98x100 ft., three stories high, to cost $70,000.

Galena, Ill.—Several short electric extensions to serve farmers near Platteville and Hazel Green are being run by the Interstate Light, Heat & Power Co. at the expense of the farmers.

Mound City, Ill.—G. Murphy will expend $20,000 for the equipment for the Mound City ice plant.

Ottawa, Ill.—Illinois Farmers Packing Co. will erect $100,000 addition to plant and will install $50,000 worth of equipment. The new building will be 95x45 ft., four stories and basement.

Springfield, Ill.—The sum of $600,000 in bonds has been authorized to finance the municipal light plant. Address Commissioner Walter J. Spaulding.

Antigo, Wis.—Red River Manufacturing Co., whose plant at Phlox was destroyed by fire Nov. 4, will rebuild on a larger scale.

Oshkosh, Wis.—Doman Manufacturing Co., which has acquired the assets of the Oshkosh Washing Machine Co., will build a one-story plant addition, 40x200 ft., and enlarge its power plant. H. C. Doman is general manager.

Grand Rapids, Minn.—Prairie River Power Co. has been granted permission to construct a dam in falls of Prairie river as soon as construction contract can be let. A high-tension transmission line will also be constructed.

New Ulm, Minn.—Minnesota Flint Rock Co. contemplates erection of a high-tension line from light plant to its quarry at Redstone. Address A. R. Voss.

Shevlin, Minn.—The city contemplates erecting an electric light plant. John N. Desjardins, village recorder.

St. Paul, Minn.—A 100-kw. electric brass furnace has been installed by the Union Brass & Metal Co., and will be in operation within thirty days. Electric current will be supplied by the Northern States Power Co.

Ulen, Minn.—J. F. Heiberg will install electric lighting system and power.

Sac City, Iowa—Thirty farmers of Sac county have incorporated the Pleasant Hill Electric Co., which will construct and operate a high-tension electric line in Clinton and Bayer Valley townships.

Sioux City, Iowa—The work of inspecting the Bell telephone line between Sioux City and Sioux Falls has just been completed by a crew of men working under the direction of John Duncan of St. Cloud, Minn. This inspection is a preliminary survey, the ultimate object of which is the virtual rebuilding of the line in 1920. The improvement work on this is expected to begin in the spring. Estimated cost $100,000. Copper wires will replace the worn copper and steel wires with which the line is equipped at present.

Koshkonong, Mo.—It is reported that the Missouri Iron & Steel Corp., St. Louis, plans a hydroelectric development here.

Lexington, Mo.—Lexington Electric Co. contemplates the erection of a transmission cable across the Missouri river and to Richmond. Estimated cost, $50,000.

Richmond, Mo.—A new lighting system to cost approximately $35,000, will be installed by the city. Address city clerk, Richmond.

Wichita, Kans.—An estimate of $6250 was presented the city commissioner as the cost of installing system of lighting on First street, from Main to Water street, and on Water street from First street to Douglas avenue. The cost will be apportioned among property owners.

Kimball, Neb.—Bond issue for $25,000 issued for additional electric light construction was purchased by the Lincoln Trust Co., 126 North 11th street, Lincoln.

Armour, S. D.—Townships of Ethan and Dimock have raised $25,000 for installing lights here.

Claire, S. D.—Special election has

been held which authorized village to construct an electric distributing system and purchase current from New Effington Electric Co., New Effington.

Hartford, S. D.—Hartford Light & Power Co. will extend its wires to Chancellor to furnish electric lights.

Sioux Falls, S. D.—A local quarry will increase its daily output to 800 cu. yds. or four times its present capacity by means of new machinery to be installed soon.

Calvin, N. D.—Plans are in progress for establishing an electric light plant.

Carthage, N. D.—City granted L. W. Liddle a franchise to install an electric light plant.

Fargo, N. D.—The city commission will take immediate steps to obtain estimates on the cost of an electric light plant of sufficient capacity to supply the city.

Sawyer, N. D.—Cook Robinson has been granted franchise to install an electric light system. Contracts have been let to Northwestern Electric Co., Minot, N. D.

SOUTH CENTRAL STATES.

Covington, Ky.—Willard Manufacturing Co., manufacturer of machine tools, plans the erection of a one-story building, 63x160 ft.

Harland, Ky.—Bowers Manufacturing Co. will install electrically driven lathe, hammer, etc.

Kaplan, La.—Electrical equipment will be purchased for the light plant. Address Eugene Clymer, mayor.

Hobart, Okla.—City is planning for the issuance of bonds for $135,000, the proceeds to be used for the installation of a new municipal electric light plant.

Miami, Okla.—Miami Traction Co. is understood to be arranging plans for the rebuilding of its electric power plant recently destroyed by fire, with loss estimated in excess of $75,000. B. B. Tatum is president.

Oklahoma City, Okla.—Deignan Motor Co. will construct a $200,000 factory for rebuilding Fords.

Pawhuska, Okla.—The system of municipal electric lighting and water works will be improved here shortly through the addition of new generating machinery and pumping apparatus. The present lighting equipment has proved inadequate to meet the demands of the city.

Tonkawa, Okla.—Bonds to the amount of $15,000 have been voted for improving electric light service. Johnson & Benham, consulting engineers. Firestone building, Kansas City, Mo.

Albany, Tex.—Albany Light & Power Co., which has been incorporated with a capital of $30,000, will install an electric light and power plant. The incorporators are: T. B. Wood, J. J. Mahan and R. A. Cox.

Brady, Tex.—Contract has been awarded by the city council for the installation of a new municipal electric plant.

Kileen, Tex.—City Light & Power Co. has had plans prepared for the reconstruction of its electric light and power plant, recently destroyed by fire with loss estimated at about $28,000.

Wichita Falls, Tex.—Wichita Falls Electric Co. has increased its capital stock from $775,000 to $1,775,000. It plans to make large additions to its electric light and power plant here.

WESTERN STATES.

Drummond, Mont.—Drummond Light & Power Co. has organized with capital stock amounting to $10,000. H. J. Faust, chairman of board of directors. Work on the installation of the plant will be started at once.

Superior, Mont.—Montana Power Co. is now surveying a line from Taft to Amazon Dixie at Sildix to furnish power to that mine. Construction of the line will be commenced when the survey is completed.

Yuma, Ariz.—New King Mining Co., operating in the Kola mining district, is understood to be arranging plans for the construction of a new high-power transmission line from Yuma to its properties, a distance of approximately 70 miles. W. J. Johnson is manager of the mine.

Millville, Utah—City council has recently completed work on the construction of a new electric distributing system to be used for municipal service.

Boise, Ida.—Ashton-St. Anthony Power Co. has filed application with the Public Utilities Commission for permission to make extensions in its transmission system to the municipality of Drummond, Fremont county.

Sandpoint, Ida.—Western Pole Preserving Co. is installing an additional 43 hp. in motors for the operation of the plant at Sandpoint. Electrical energy is furnished by the Mountain States Power Co.

Petersburg, Alaska—City council has acquired a site for a hydroelectric power plant, and the plans are to build a plant of the capacity of 5000 hp.

Burbank, Wash.—The Burbank Irrigation district has voted a bond issue of $400,000, the proceeds of which are to be used to complete the water system of that project. An expenditure of $200,000 will be required to line 18 miles of canals with concrete. Another requirement will be the installation of two auxiliary pumping units for which electric motors will be used.

Centralia, Wash.—The city commission has signed a contract with the Sherman County Light & Power Co. to furnish current to the city for the five-year period from Oct. 1, 1920.

Centralia, Wash. — Washington Light & Power Co. is considering the erection of a plant here.

Wenatchee, Wash.—As a solution to the power problem of the Wenatchee Valley, General Manager George D. Brown of the Wenatchee Valley Gas & Electric Co. has submitted to the power users and the public a proposition to buy the bonds necessary to finance an enlargement of the Chelan Falls plant. It is estimated that the cost of adding another 1000 hp. to the Chelan Falls plant will be $80,000. The company proposes to issue first mortgage bonds bearing 6% interest, secured by this plant and the contracts for the sale of the power and asks the power users of the valley to buy these bonds, so that the machinery can be ordered and the unit installed in time for next season's business. The Wenatchee Valley Power Users' Association and the special committee of the commercial club voted unanimously to endorse the plan.

Astoria, Ore.—The Port Commission has taken up the matter of installing an underground electric power system throughout the port property.

Astoria, Ore.—Power house of the Pacific Power & Light Co. has been damaged by fire. Loss amounting to $20,000.

Astoria, Ore.—Pacific Power & Light Co. has recently inaugurated work on the construction of its proposed electric station. It is understood that large oil-operated turbines will be installed.

Portland, Ore.—Canadian Marconi Wireless Co. is understood to be arranging plans for the construction of a large new high-power wireless station in the vicinity of Vancouver, B. C., which will be the most powerful radio depot in the British Empire, it is said, when completed. The station is estimated to cost in the neighborhood of $2,000,000.

The Dalles, Ore.—Cluster lights will be installed along Second street, the main thoroughfare of the city. Ten city blocks will be lighted with three clusters to each block.

Avalon, Calif.—City council has completed plans for the installation of new generating equipment at the municipal electric light plant.

Calipatria, Calif.—Imperial Utilities Corp., which recently completed negotiations for the acquirement of a waterworks plant at Calipatria and Niland, as well as at Monterey Park. The company operates a water works and ice manufacturing plant at Barstow, and has filed application with the Railroad Commission for permission to issue bonds for $54,000, a portion of the proceeds to be used for the construction of a new ice plant and improvements in the various plants.

El Centro, Calif.—An election will be held to decide the question of issuing $30,000 in bonds for a new light system. Address Mayor George Watkins.

Fillmore, Calif.—Board of trustees is considering plans for the issuance of bonds to cover the cost of the installation of a new water supply system, including necessary equipment such as pumping units, drilling of wells, etc.

Fullerton, Calif.—City council is arranging plans for the installation of a new electric lighting system in sections of Spadra and Commonwealth avenues, as well as in the residential districts. It is proposed to utilize

cast iron lighting standards for the former installation, and Marbelite standards for the latter service.

Los Angeles, Calif.—The city attorney, city engineer and city electrician were instructed by the city council to prepare the necessary ordinance for the ornamental districts of Los Angeles. It is proposed to ask for bids covering the period of 5 years, from July 1, 1920, to June 30, 1925, on 41 ornamental lighting systems. The city's proportion of the cost of maintaining the systems is $23,893 per year.

Richmond, Calif.—City council is considering plans for the installation of a new electrolier street lighting system in the business section of the city. The installation will cover Washington, Macdonald, Barrett, and Richmond avenues, as well as other thoroughfares.

Salinas, Calif.—City council has plans under consideration for the installation of a new ornamental street lighting system on Market and North Main streets.

NEW PUBLICATIONS

Some Tests of Light Aluminum Casting Alloys; the Effect of Heat Treatment is the title of technologic paper No. 139 issued by the Bureau of Standards, Washington, D. C. The mechanical properties of a number of different compositions of cast light aluminum alloys have been determined as well as the resistance to the action of alternating stresses of three commonly used alloys. Comparison was made of the resistance of some well known alloys to corrosion in the salt spray test. It was found that the effect of heat-treatment of cast alloys, consisting of annealing at 500°C and cooling in air from that temperature, followed by aging for several days before testing, produced an increase in the tensile strength and the hardness, with an attendant decrease, usually, in the elongation. The application of such a heat-treatment to light aluminum castings seems to have commercial possibilities. The price of this publication is 10 cts. and copies may be obtained by addressing a request to the Bureau.

Electrical Goods Trade on the East Coast of South America—Opportunities for American electrical goods in Argentina, Uruguay, and Brazil are described in this booklet now being distributed by the Bureau of Foreign and Domestic Commerce, Department of Commerce. It is the work of Trade Commissioner Philip S. Smith, whose previous reports on other Latin-American markets are well known to the trade. The use of electricity is widespread in Argentina, Uruguay, and Brazil, but especially so in the last named, where there is abundant waterpower. In all three the work of the American manufacturer is cut out for him, as competition will soon be keener than ever it was before the war. The price of this booklet is 20 cts. and copies may be obtained by addressing the Superintendent of Documents, Washington, D. C., or to any of the district offices of the Bureau of Foreign and Domestic Commerce.

PROPOSALS

Electric Pumps.—Bids will be received for the purchase of four electric pumps to be installed in the city pumping station, Sault Ste. Marie, Mich. Address A. J. Eaton, city clerk.

Ranges and Ovens.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for 8 electric ovens for delivery at eastern yards, and 6 electric ranges for delivery at South Brooklyn and Mare Island yards. (Schedule 4937.)

Pumping Equipment, Etc.—Eugene Eleazar, mayor of Kaplan, La., will receive bids until Nov. 25 for extensive improvements in the municipal light and water plants, including the installation of new pumping equipment, alternator, switchboard, and auxiliary apparatus. Xavier A. Kramer, Magnolia, Miss., is consulting engineer.

Electric Light Plant.—Bids will be received Nov. 19 by the mayor of Rolling Fork, Miss., for furnishing all materials and constructing a water works and electric light plant. The work consists of a power house building, oil-engine pumping machinery, alternators, switchboards, reservoir, water pipe lines, tower and tank, electric lines and street lighting system. Address J. B. Sinai, mayor. Xavier A. Kramer, consulting engineer, Magnolia, Miss.

Machines and Machine Tools.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for electric hoisting cranes, delivery at various navy yards (Schedule 4938); electric portable drills, delivery at various eastern and western yards (Schedule 4968); electric bench grinders, delivery at various eastern and western yards (Schedule 4968), and one motor-driven shaping machine, delivery at Washington navy yard (Schedule 4994).

Electrical Material.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for the following material: 2 Type B annunciators, for delivery at Brooklyn navy yard (Schedule 4993); 3000 ft. brush-holder cable and 300 lbs. underwriters' wire, delivery at Mare Island (Schedule 4983); a miscellaneous quantity of lighting and power cable, lighting and power wire, incandescent lamp cord and 15,000 ft. triple-braid weatherproof wire, for delivery at Mare Island (Schedule 4982); turbogenerators, delivery at Puget Sound (Schedule 4810); 9 automatic motor compensators, delivery at Washington navy yard (Schedule 4809); miscellaneous electrical equipment, f. o. b. (Schedule 4806); 150 lbs. phosphor-bronze wire, delivery at Boston (Schedule 4966).

FOREIGN TRADE

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Copper Wire (31,183).—A merchant in Argentina desires to purchase iron in bars, woods, construction materials, copper wire, hardware in general, and will also accept commissions, shipments and agencies. References.

Electrical Measuring Instruments (31,190).—The general purchasing agent of a firm in Spain desires to purchase and secure an agency of iron-piping installations, with faucets, valves, connections, etc.; belting for power transmission; greases and mineral oils; electrical measuring instruments (meters), and electrical equipment of all kinds; and gas motors. Quotations should be given c. i. f. Spanish ports. Correspondence should be in Spanish. References.

Motors, Turbines, Etc. (31,191.)—A commercial agent in Belgium desires to secure an agency for the sale of all kinds of articles connected with heating installation, such as boilers, radiators, taps, ventilators, turbines, motors, hydrometers, thermometers, regulators, tools, and joints in asbestos and rubber. Quotations should be given c. i. f. Brussels or Antwerp. Correspondence may be in Spanish.

Electrical Goods (31,194).—Agencies are desired by a firm in France for the sale of textiles, rubber goods and electrical goods. Correspondence should be in French. References.

Electrical Machinery (31,203).—An agency is desired by a man in Italy for the sale of hydraulic turbines, machine tools, electrical machinery and supplies, and mechanical goods in general. Correspondence may be in English. Reference.

Motors, Machinery, Cables, Etc. (31,207)—A company in Greece desires to secure agencies from manufacturers for the sale of iron concrete reinforcement bars; structural and shipbuilding sheets; steel iron and copper pipes; internal-combustion engines; Diesel and semi-Diesel engines, principally of small power; 2 to 6 hp. engines suitable for well pumping, also 10 to 25-hp. engines for small flour mills, etc.; marine engines, 100 to 300 hp.; windmill pumps; cylinder flour mill of from 5 to 10 tons daily output for country districts; electric motors and other electrical machinery and appliances, telephones, etc.; plain and insulated electric cables and wires; and steel ropes and wires. References.

Vacuum Cleaners (31,209).—A company in England desires to secure agencies for the sale of electric vacuum cleaners and all kinds of labor-saving devices for the home. Quotations should be given c. i. f. English port, or f. o. b. New York. References.

Personal

H. L. Everest Sales Manager of Hart & Hegeman — L. H. Kinnard New President of Pennsylvania Bell Telephone

GEORGE M. GRIFFITH is now in the construction department of the Oklahoma Gas & Electric Co., in charge of substation construction at Sapulpa, Okla.

R. C. GOSROW, sales engineer for the Pittsburgh Furnace Co., Milwaukee, Wis., has opened a branch office for that company at 504 Maynard building, Seattle, Wash.

C. C. DAVIS, field representative of the California Electrical Co-operative Campaign for the San Francisco district, has resigned to become manager of the electrical department of the Turner Hardware & Implement Co., Modesto, Calif.

WILLIAM A. BAEHR, consulting engineer of Chicago, through the purchase of the Southern Illinois Light & Power Co., Hillsboro, Ill., has been elected president of that company, taking up the duties of J. J. Frey, of St. Louis, formerly president of the company.

WARREN B. LEWIS, Providence, R. I., has been appointed provisional manager of the Taunton (Mass.) municipal lighting plant. Mr. Lewis maintains consulting engineering offices in the Grosvenor building, Providence, but will devote considerable time to problems of the Taunton plant.

O. A. JENNINGS, formerly manager of the oil field electrification department of the Oklahoma Gas & Electric Co., has been appointed manager of the commercial department of the company with supervision of the commercial activities of the company throughout the state of Oklahoma, with headquarters at Oklahoma City.

J. P. DAVIS, purchasing agent of the Belden Manufacturing Co., has been elected president of the Purchasing Agents Association of Chicago. Mr. Davis was formerly assistant purchasing agent for the Standard Underground Cable Co., of Pittsburgh, coming with the Belden Manufacturing Co. as purchasing agent in 1916. The position in the Purchasing Agents Association, which he now holds, is especially important since the 1920 convention of the national association is to be held in this city.

E. B. CRAFT, assistant chief engineer of the Western Electric Co., delivered an interesting address at a meeting of the Rochester (N. Y.) Section of the American Institute of Electrical Engineers, held at Rochester, N. Y., on "Wartime Electrical Communciations." Mr. Craft served as a major in the United States Signal Corps, and the lecture was illustrated with stereopticon slides, showing pictures of wire and wireless telegraphy and telephony, airplane control, airplane and gunfire detection, as well as submarine detection.

JAMES H. MANNING, consulting hydraulic engineer for Stone & Webster, was recently appointed assistant engineering manager. Mr. Manning joined the Stone & Webster staff in 1910 and served as superintendent of construction in the Franklin, Verdi and White Salmon hydroelectric developments, besides preparing various engineering reports. He later was placed in charge of the hydraulic division, and in 1917 he became chief engineer of the American International Shipbuilding Corp. Early in 1919 Mr. Manning was made consulting hydraulic engineer for Stone & Webster, continuing in this capacity until his recent promotion.

H. L. EVEREST, one of the best known and most popular electrical men in the Middle West, has just been appointed general sales manager of the Hart & Hegeman Manufacturing Co., Hartford, Conn. Although a native of the East, Mr. Everest has resided in Chicago for the past 12 years where he has made a host of friends who rejoice at his well earned promotion. He joined the sales force of the Hart & Hegeman company Jan. 29, 1907, his headquarters being in the Chicago territory. In October, 1914, owing to the death of G. S. Searing, he was made western sales manager, which position he has held continuously since. In this capacity Mr. Everest obtained a thorough understanding of the problems of the electrical industry that will be of peculiar advantage to him in his new position. He was born at Lyon, N. Y., and spent his early life at New Haven, Conn. Previous to his connection with Hart & Hegeman he was employed for five years by the New York, New Haven & Hartford railroad. He is a member of the Jovian Order and the Electric Club of Chicago, having been particularly active in the latter.

Haynes L. Everest.

B. H. GARDNER, for the past two years manager of the New Britain district of the Connecticut Light & Power Co., has been promoted to the position of sales manager of the commercial department of the company with headquarters in Waterbury, Conn. He is succeeded by N. S. Franklin, assistant superintendent.

CHESTER BARNHART, formerly auditor of the Oskaloosa Railway, Light & Gas Co., Oskaloosa, Iowa, has accepted a position as office manager and auditor of the Urbana & Champaign Railway, Gas & Electric Co., with headquarters at Champaign, Ill. Both properties are owned by the Illinois Traction System or the McKinley syndicate as it is known.

L. H. KINNARD, after 30 years' service with the Bell Telephone Co. of Pennsylvania, has been elected president of the company and head of the eastern group of telephone companies of the American Telephone & Telegraph Co., to succeed Frank H. Bethell, resigned. Mr. Kinnard entered the service of the old Pennsylvania Telephone Co. at Harrisburg in 1888 as clerk, a year later became assistant local manager, and after a few years local manager at Carlisle, then at Harrisburg. In 1896 he became division superintendent of the southern division of that company, with headquarters at Harrisburg, and in 1902 was advanced to general superintendent and the same year was made general manager. In 1908, the Bell Telephone Co. was formed, the various companies being consolidated, and Mr. Kinnard moved to Philadelphia as general contract agent in charge of what is now known as the commercial department. In November, 1912, he became second vice-president and general manager of the companies, continuing in this capacity until the present time, the word "second" being dropped from his title in 1913. Mr. Kinnard's career in the telephone field has been a long and comprehensive one and he has helped to lead the service and the Bell system through its difficulties and has contributed much toward making the system what it is today. Mr. Kinnard will continue to make his headquarters in Philadelphia. He will be succeeded by John C. Lynch, general superintendent of traffic.

Obituary.

FREDERICK W. WALLACE, Plainfield, N. J., general manager and treasurer of the Waclark Wire Co., Elizabeth, N. J., died on Oct. 30 at his home, following a short illness with pneumonia. Mr. Wallace was 55 years of age.

For the Readjustment Period—What?

LVIII.

Seventh National Foreign Trade Convention

One of the important features of the Seventh National Foreign Trade Convention, to be held at San Francisco, Cal., May 15-20, 1920, will be the world conference of American foreign traders, according to preliminary announcements just mailed to American firms represented at previous conventions, who are requested to have their representatives, living or traveling abroad, time their visits to this country so as to take advantage of the valuable opportunities afforded by this Convention.

Three special steamers, chartered for the accommodation of delegates from abroad, will be provided for the ports on the Pacific Ocean. Another steamer starting from New York, will go by way of the Panama Canal.

Information regarding steamer routes, days of sailing and the program of the 1920 Convention, is being furnished by O. K. Davis, Secretary, National Foreign Trade Council. No. 1 Hanover Square, New York.

This is none too soon to take up with foreign representatives, a matter of such importance. Do it now.

C. A. TUPPER *President*
INTERNATIONAL TRADE PRESS, INC., CHICAGO

Financial News

Pacific Electric Takes Over Northern California Company.

In a decision handed down by the California State Railroad Commission on Sept. 23, the Pacific Gas & Electric Co. was given authority to purchase the properties of the Northern California Power Co. at a purchase price of approximately $10,000,000. This includes a funded indebtedness of about $6,250,000 and a small floating debt, to be taken care of, in addition to the purchase of 100,000 shares of the stock at $34 a share. In the hearing before the commission it was stated that the investment cost of the properties of the Northern California Power Co. was $10,634,735, and that to reproduce these properties at the present time, allowing for the increase in the cost of labor and material, would cost, according to estimate, $13,300,000, and this without allowance of any kind for water rights and going concern value.

With the acquisition of the properties of the Northern California Power Co., the Pacific Gas & Electric Co.'s system now spreads over 33 counties of the state of California. It embraces 19 hydro-electric plants, with a total capacity of 212,000 hp.; three steam plants, with a total capacity of 120,000 hp., giving a combined generating capacity of 332,000 hp. The company now serves a total of 512,000 patrons, including consumers of gas, electricity, water and steam, and employs over 5000 persons.

Public Utilities to Finance Improvements.

A number of electric utility companies have made application to the Public Service Commission of Pennsylvania for permission to issue stock and bonds for extensions and improvements, etc., in their electric power plants and systems, as follows: Lehigh Valley Light & Power Co., Allentown, preferred stock, $1,500,000, common stock, $2,178,700; Erie Lighting Co., Erie, bonds, $47,000; Industrial Power Co., Allentown, stock, $3,500; Pennsylvania Utilities Co., Easton, bonds, $40,500; Philadelphia Rapid Transit Co., Philadelphia, certificates, $288,000; Clarion Electric Co., Clarion, bonds, $20,000; Pennsylvania Power Co., Ellwood City, bonds, $9,000; Metropolitan Edison Co., Reading, preferred stock, $2,500,000; Shenango Valley Electric Light Co., Sharon, bonds, $82,000; Mahoning & Shenango Railway & Light Co., New Castle, bonds, $557,000; New Castle Electric Co., New Castle, bonds, $21,000; Pennsylvania Utilities Co., Easton, bonds, $40,500; and the Red Bank Electric Co., New Bethlehem, bonds, $47,500.

Chicago Pneumatic Tool Stock to Be Doubled.

Doubling the capital stock of the Chicago Pneumatic Tool Co. from $6,448,800 to $12,897,600 was recommended recently by the directors and will be voted on by the stockholders at a meeting on Dec. 5. The capital stock will be increased from 64,488 to 128,976 shares of $100 par value and stockholders will be offered the privilege of subscribing for one share of new stock for each share now held.

From the proceeds of the sale of the new stock the company's $3,250,000 first serial gold 6% bonds will be retired and current indebtedness of $720,000 will be paid off. The remaining sum will be added to working capital. The new stock has been underwritten by a New York investment banking house.

Waupaca Electric Light Files Dissolution.

The Waupaca Electric Light & Railway Co. has filed announcement of dissolution at the offices of the secretary of state. The concern was incorporated June 27, 1898, with a capitalization of $75,000. In 1904 the capital was increased to $125,000, but in 1909 reduced to the original figures.

Interstate Public Service to Issue Bonds.

The Interstate Public Service Co. has petitioned the Indiana Public Service Commission for permission to issue $146,000 of first and refunding mortgage gold bonds at par and $353,000 of other first and refunding mortgage gold bonds at 80% of par. The first issue is to reimburse the company treasury to within 75% of the expenditures already made for improvements and acquisitions. The second issue is to finance 75% of the proposed improvements and to buy additional equipment for its plants in various parts of Indiana.

Telephone Company Earnings.

A statement showing surplus earnings of $343,000 in the months of July, August and September, after paying dividends of 8% and paying 4% of the gross receipts to the American Telephone & Telegraph Co. has been filed by the Chicago Telephone Co. with Comptroller George F. Harding. Previous reports, for months in which the former flat rates were in effect, showed losses on the part of the company.

The State Public Utilities Commission has impounded part of the collections made by the telephone company, and Special Assistant Corp. Counsel Chester E. Cleveland is laying the groundwork for a demand that refunds be made to telephone users whose rates have been increased.

Arcwell Corp., 514 West Forty-sixth street, New York City, manufacturer of electric welding machines, etc., has filed a petition in bankruptcy, with schedules showing liabilities of $80,214 and assets of $41,629, consisting of stock, notes, accounts receivable, bank balance, etc.

Dividends.

The Central Arkansas Railway & Light Corp. has declared a quarterly dividend of 1¾% on preferred stock, payable Dec. 1 to stock of record Nov. 1.

Electric Investment Corp. has declared a quarterly dividend of 1¾% on preferred stock, payable Nov. 22 to stock of record Nov. 6.

Norfolk Railway & Light Co. has declared a semi-annual dividend of 5%, payable Dec. 1 to stock of record Nov. 15.

Earnings.

VIRGINIA RAILWAY & POWER.

The Virginia Railway & Power Co. reports for the year ended June 30:

	1919.	1918.
Gross	$8,429,283	$7,457,530
Net	3,190,521	3,472,902
Surplus after charges.	435,332	958,645
Preferred dividend ..	239,976	479,952
Common dividend ...	*300,679	179,243
Surplus	def. 105,323	299,450

*Paid in stock of Old Dominion Iron & Steel Corp.

STANDARD GAS & ELECTRIC CO.

Combined earnings of Standard Gas & Electric Co. subsidiaries for the month of September and for the year ended Sept. 30, 1919, compared with the corresponding period a year ago, are reported as follows:

Month of September—	1919.	1918.
Gross earnings	$2,061,426	$1,813,783
Net earnings	711,099	625,287
Year ended Sept. 30—		
Gross earnings	26,268,478	22,056,918
Net earnings	9,667,933	8,592,205

This statement does not include any earnings of Shaffer Oil & Refining Co.

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities.	Div. rate. Per cent.	Bid Nov. 11.
Adirondack Electric Power of Glens Falls, common	6	14
Adirondack Electric Power of Glens Falls, preferred	6	16
American Gas & Electric of New York, common	10+extra	126
American Gas & Electric of New York, preferred	6	40
American Light & Traction of New York, common	..	210
American Light & Traction of New York, preferred	6	93
American Power & Light of New York, common	4	54
American Power & Light of New York, preferred	6	72
American Public Utilities of Grand Rapids, common	..	8
American Public Utilities of Grand Rapids, preferred	7	25
American Telephone & Telegraph of New York	..	98⅝
American Water Works & Elec. of New York, common	..	5¼
American Water Works & Elec. of New York, particip	7	10
American Water Works & Elec. of New York, first preferred	..	53
Appalachian Power, common	..	4
Appalachian Power, preferred	7	20½
Cities Service of New York, common	+extra	455
Cities Service of New York, preferred	6	77½
Commonwealth Edison of Chicago	8	111
Comm. Power, Railway & Light of Jackson, common	..	23
Comm. Power, Railway & Light of Jackson, preferred	6	48
Federal Light & Traction of New York, common	..	9
Federal Light & Traction of New York, preferred	..	44
Illinois Northern Utilities of Dixon	6	..
Middle West Utilities of Chicago, common	2+extra	25
Middle West Utilities of Chicago, preferred	6	52
Northern States Power of Chicago, common	..	64
Northern States Power of Chicago, preferred	ex. div. 7	90
Pacific Gas & Electric of San Francisco, common	..	62½
Pacific Gas & Electric of San Francisco, preferred	6	..
Public Service of Northern Illinois, Chicago, common	7	80
Public Service of Northern Illinois, Chicago, preferred	6	85
Republic Railway & Light of Youngstown, common	4	14
Republic Railway & Light of Youngstown, preferred	6	49
Standard Gas & Electric of Chicago, common	..	30½
Standard Gas & Electric of Chicago, preferred	6	41½
Tennessee Railway, Light & Power of Chattanooga, common	..	4
Tennessee Railway, Light & Power of Chattanooga, preferred	6	10
United Light & Railways of Grand Rapids, common	4	40
United Light & Railways of Grand Rapids, preferred	6	71
Western Power of San Francisco, common	..	22
Western Union Telegraph of New York	extra	86
Industries.		
Electric Storage of Philadelphia, common	4	141
General Electric of Schenectady	8	170½
Westinghouse Electric & Mfg. of Pittsburgh, common	7	55
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	..